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UTILIZE A NOVEL INOCULANT (MID/1) TO IMPROVE THE NUTRITIONAL VALUE OF THE CORN SILAGE AND ITS EFFECT ON MILK PRODUCTION OF EGYPTIAN DAIRY BUFFALO AND CATTLE

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SUMMARY

The purpose of this study is to determine the effects of using the MID/1 as a biological inoculant on the feed intake, nutritive value, digestion coefficients, milk yield and net economic return of corn silage in dairy cattle and buffaloes. Twenty dairy buffaloes (582 kg) and 12 dairy cattle (595 kg) in total were used, and they were each randomly divided into two symmetrical groups. The control group was fed untreated corn silage. MID/1 group (n=6 for cattle and 10 for buffaloes), fed corn silage treated with MID/1 inoculant. *In vivo* digestibility coefficients and nutritive value were determined using silica as an internal indicator. The feed intake, feed residues, dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen-free extract (NFE) and lactate and acetate acids of treated and untreated corn silage and concentrate feed mixture (CFM) were determined. The milk yield, fat and protein percentages of lactating cattle and buffaloes were recorded daily. The nutritive value and digestion coefficients of DM, OM, CP, CF and EE in the MID/1 group were significantly higher than those of untreated corn silage. The milk yield was increased significantly by 9.02% for cattle and by 9.68% for buffaloes in the MID/1 group compared to the untreated group (27.8 and 11.9 *vs.* 25.5 and 10.85 kg/head/day, respectively). The milk fat percentage was slightly increased in both cattle and buffaloes but did not differ in the inoculated corn silage group compared to the untreated corn silage group (3.65 and 8.28 *vs.* 3.5 and 8.0%, respectively). The net return for cattle and buffaloes in the MID/1 group was 20129.55 and 5385.45 LE/head/105 days, respectively, as opposed to 17241 LE/head/105 days for cattle and 3757.95 LE/head/105 days for buffaloes in the untreated group. The present results indicated that the treated corn silage with DIM/1 inoculation improved the nutritive value and digestion coefficients, increasing the milk yield and net economic return compared to the untreated corn silage.

Keywords: *Microbial inoculants, corn silage, dairy cattle and buffaloes and digestibility.*

INTRODUCTION

Animal feed ingredients and their availability are very important items which affect the production of dairy farms. The shortage of animal feeds and their components is the most serious problem facing animal production in Egypt, especially on milk farms. The shortage in animal feeds is estimated at about 4.8 million tonnes (Shoukry, 2019), which is reflected negatively on the productive capacity of livestock production in Egypt. One of the best economic methods to improve the nutritional value of many green agricultural wastes is to convert them into silage. Silage is defined as green fodder kept in non-aerobic fermentation, leading to the production of lactic and acetic acids in quantities sufficient to stop harmful bacterial activity, which helps to preserve the nutritional value of green fodder (McDonald *et al.,* 1991).

In corn silage, which is fed to dairy animals as a source of fibre and energy, starch serves as the primary source of energy and a critical component for high-yielding dairy cows (Bernardes, 2012; Jensen *et al.,* 2005 and Neville *et al.,* 2022). The silage process' primary goal is to quickly reduce pH. In order to accomplish this, lactic acid bacteria (LAB) convert water-soluble carbohydrates into lactic acid. These bacteria can be classified as homofermentative or heterofermentative species depending on how their fermentation turns out. Homofermentative species are better adapted for preservation than heterofermentative species, which only create acetic acid, ethanol and carbon dioxide, which are less successful at reducing pH. Homofermentative species also produce two molecules of lactate for every sugar molecule.

Furthermore, reducing pH prevents the growth of clostridia and strictly anaerobic bacteria, which otherwise create propionic acid and butyric acid from lactic acid and water-soluble carbohydrates (WSC). Additionally, the breakdown of protein results in the production of amines and ammonia, which lowers the quality of the silage (Woolford, 1984; McDonald *et al.,* 1991; Okoye *et al.,* 2022 and Dong *et al.,* 2022). Corn silage for dairy cattle and buffaloes had been produced using the specialized microbial inoculant (MID/1). This biological inoculant consists of specialist and suitable groups of highly genetically engineered lactic acid bacteria as well as certain anaerobic bacteria. The MID/1 inoculant raises the proportion of lactic acid and maintains a ratio between the lactic and acetic acids of at least 1:3 since acetic acid is a crucial component of milk fat. Therefore, the objective of this study was to investigate the effect of MID/1 inoculant on the quality of corn silage and its effect on feed intake, milk yield, milk fat and protein percentages in dairy cattle and buffaloes.

MATERIALS AND METHODS

Inoculant preparation:

Silage for dairy cattle and buffaloes had been made using the specialized microbial inoculant (MID/1). This is a biological inoculant that contains compatible and specialized groups of highly genetically improved *Lactobacillus rhamenosus D33 mutants* and the fusant No. 5/9 obtained after the interspecific protoplast fusion was carried out between *Lactobacilluscasei subsp*. *Rhamnosus No. 45* and *Lactobacillusamylovorus No. 40* (Khattab, 2002), as well as *Lactobacillus plantarum No. 77*, anaerobic bacterial strain *coagulans No. 173* and yeast strain (*LipomycesstarkeyiY-LS*) were used. All microbial strains were obtained from the Applied Microbial Genetics Laboratory, Genetics and Cytology Department, National Research Centre, Cairo, Egypt. Lactic acid bacterial strains were inoculated in MRS (De Man, Rogosa and Sharpe) broth and incubated at 37°C for 48h. The anaerobic bacterial strain was grown in an optimum medium composition containing 10 g/L glucose, 5 g/L yeast extract and 10 g/L peptone, pH 7.0, and incubated at 37°C for 48 h, according to Li *et al.* (2022). The yeast strain was grown in a basal culture medium and incubated at 30°C for 48 h, according to Huang *et al.* (2011). In order to make an inoculant (MID/1) for one ton of corn silage, 200 ml of each strain were mixed before use. Also, the dry powder (500 g) of whey was used for one ton of corn silage.

Ensiling process:

The corn crop was harvested for silage after the ear is well-dented but before the leaves turn brown and dry, where the moisture content of the corn plant is between 65 and 70%, which equals 30 to 35% DM. The quantity and quality of corn silage are at their peak at this stage of development. The whole corn plant was chopped into roughly 3-4 cm-long pieces and compressed. The chopped corn was placed in layers, and the bacterial inoculant was spread on each layer until it covered the whole amount of the chopped corn. The previous steps were achieved in un-inoculated corn silage as a control (Mahanna and Chase, 2003). After 42 days for storage, the stack was opened, and, the calculated amount of corn silage was taken fresh each morning for animal feeding. The cost of the inoculant was 350 LE per 50 tonnes of silage (0.007 LE per kg of silage).

Animal feeding management:

Twenty dairy buffaloes (582 kg on average) and twelve dairy cattle (595 kg on average) were randomly divided into two symmetrical groups of each (n= 6 cattle and 10 buffaloes). The control group was fed corn silage without inoculant, and the MID/1 group was fed corn silage treated with MID/1 inoculant. The chemical analysis of CFM, non-inoculated silage and inoculated silage with MID/1 was illustrated in Table (1). The corn silage was offered to the cattle and buffaloes groups for 105 days of the feeding experiment *ad-libitum*. The feed intake, feed residue and milk production of dairy cattle and buffaloes were recorded. The DM, CP, CF, EE and NFE of inoculated and non-inoculated silage and CFM were determined according to AOAC procedures (2000). The percentages of milk fat and protein were determined using infrared spectrophotometry according to AOAC (2000). Fat-corrected milk (FCM, 4% fat) was calculated by using the following equation: FCM = (0.4 × kg of milk yield) + (15 × kg of milk fat yield), according to Gains (1928).

Lactate and acetate acid determination of corn silage:

To calculate the percentages of lactate and acetate acids, corn silage's supernatant was separated. The silage sample was homogenized for 4 minutes after being diluted 1:5 with distilled water and then centrifuged at 10,000 g for 20 minutes. The supernatant was filtered through a membrane filter with a 0.2-micron pore size (Pall Gellman Sciences) (HPLC 1047A). High-performance liquid chromatography was used to determine the percentages of lactate and acetate acids (Danner *et al.,* 2003).

In vivo digestibility:

Three cattle and buffaloeses from each group were used in the digestibility trial in order to assess the impact of inoculated silage with DIM/1 on the digestion coefficients. A digestibility trial was conducted using silica as an internal indicator for the determination of digestibility, according to McDonald *et al.* (1995). For each experimental group, feed intake and feed residue were recorded and weighed daily to the nearest 5 g. The chemical analysis of the experimental rations was carried out according to AOAC (2000). Rectal fecal samples were manually collected for five successive days, sprayed with 10% sulphuric acid and 10% formaldehyde, and dried at 70◦C for 24 hours in a drying oven, then at 105 ˚C for 3 hours. Dried feces were kept in tight plastic bags for chemical analysis, according to AOAC (2000). The digestibility coefficient was calculated using the following formula:

Digestibility coefficient=100-{100 x ([% of indicator in feed/% of indicator in feces] x [% of nutrient in feces / % nutrient in feed])}, according to Crampton and Harris (1969).

Statistical analysis:

Data were statistically analyzed using one way analysis of variance. The General Linear Model of SAS (1996) was applied. The model used was:

$$Y_{ij}=\mu+T_i+e_{ij}$$

Where: Y_{ij}= the parameters under analysis, μ= the overall mean, T_i= the effect due to treatment and e_{ij}= the experimental error.

Economic feasibility study:

The economic feasibility was calculated to evaluate the effect of inoculated silage with MID/1 on feed intake costs and milk yield returns for dairy cattle and buffaloes.

RESULTS

Silage chemical analyses:

The chemical analyses of inoculated silage with MID/1 and non-inoculated silage are shown in Table (1). The nutritive value of treated corn silage with MID/1 inoculant was increased significantly, where the values of DM, CP, EE and total digestible nutrients (TDN) were increased (P>0.05) compared to the non-inoculated silage (control). The CF was decreased significantly in silage treated with MID/1 inoculant compared to control. Moreover, the pH degree and lactic and acetic acids of treated silage with MID/1 inoculant were increased (P>0.05) compared to the control. Increasing the pH degree and lactic and acetic acids of treated silage with MID/1 inoculant to prevent the growth of harmful bacteria might affect the physical characteristics of the silage product. The palatability of treated silage with MID/1 was observed to be higher for both dairy cattle and buffaloes compared with control silage.

Table (1): Chemical analysis of concentrate feed mixture (CFM), non-inoculated silage and inoculated silage with MID/1.

Item	Experimental rations		
	CFM*	Non-inoculated corn silage	Inoculated corn silage
Chemical analysis %			
DM	88.9	35.0^{b} ±0.04	39.0^{a} ±0.05
CP	14.18	8.21^{b} ±0.22	11.5^{a} ±0.09
CF	13.60	25.15^{a} ±0.05	21.1^{b} ±0.05
EE	3.5	1.98^{b} ±0.17	$.43^{a}$ ±1.28
Ash	10.40	4.84^{b} ±0.48	5.98^{a} ±1.88
NFE	58.32	59.82^{b} ±1.32	57.12^{a} ±1.31
pH	-	3.5^{b} ±0.33	3.9^{a} ±0.32
Individual organic acids % of DM			
Lactic acid	-	5.5^{b} ±1.88	7.4^{a} ±1.18
Acetic acid	-	1.5^{b} ±0.17	2.0^{a} ±0.19

a and b: means at the same column with different superscripts are significantly (P<0.05) different. DM, dry matter; CP, crude protein; CF, crud fiber; EE, ether extract and NFE, nitrogen free extract. CFM, concentrate feed mixture contains; corn 50%, soya 12%, wheat bran 15%, hay 20%, sodium chloride1%, limestone 1.5% and mixed mineral salts 0.5%.

Silage digestion and nutritive value:

The digestion coefficients and nutritive value of inoculated corn silage with MID/1 and non-inoculated silage are shown in Table (2). The digestion coefficients of DM, OM, CP, CF and EE of inoculated corn silage were significantly higher compared to untreated corn silage either in cattle or buffaloes. The value of TDN was significantly higher in inoculated corn silage compared to untreated corn silage (73.0 and 66.0%, respectively) in both cattle and buffaloes. The aforementioned results illustrated that the MID/1 enhanced the nutritive value and digestion coefficients of inoculated corn silage compared to untreated corn silage.

Table (2): The digestion coefficients, nutritive value of non-inoculated silage and inoculated corn silage with MID/1 of dairy cattle and buffaloes

Item	Experimental groups			
	Dairy cattle		Dairy buffaloes	
	Non-inoculated silage	Inoculated silage	Non-inoculated silage	Inoculated silage
Digestibility coefficients %				
DM	66.80^{b} ±0.57	70.35^{a} ±0.18	66.9^{b} ±0.57	70.95^{a} ±0.18
OM	71.84^{a} ±0.18	68.88^{b} ±0.49	68.92^{b} ±0.49	72.77^{a} ±0.38
CP	64.85 ±0.25	75.43 ±1.13	65.69^{b} ±0.05	76.66^{a} ±0.41
CF	54.66^{b}±0.62	63.48^{a} ±0.10	63.83^{b} ±0.10	66.38^{a} ±0.07
EE	70.18^{b} ±0.37	76.49^{a} ±0.4	72.79^{b} ±0.38	78.67^{a} ±0.98
NFE	69.68^{b} ±0.09	72.46^{a} ±0.38	70.22^{b} ±0.36	76.36^{a} ±1.12
Nutritive values %				
DCP	5.02^{b} ±0.07	7.98^{a} ±0.09	5.13^{b} ±0.06	8.11^{a} ±0.09
TDN	66.12^{b} ±0.57	70.98^{a} ± 0.37	66.37^{b} ±0.06	73.0^{a} ±0.34

a and b: means at the same column with different superscripts are significantly (P<0.05) different. DM, dry matter; OM, organic matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen free extract; DCP, digestible crude protein and TDN, total digestible nutrients.

Milk yield, fat and protein percentage:

The effect of inoculated corn silage with MID/1 on milk yield, fat and protein percentages of dairy cattle and buffaloes is shown in Table (3). The milk yield was increased significantly by 9.02% for cattle and by 9.68% for buffaloes in the inoculated corn silage group compared to the untreated corn silage group (27.8 and 11.9 *vs.* 25.5 and 10.85 Kg/head/day, respectively). The milk fat percentage was slightly increased in both cattle and buffaloes but did not differ in the inoculated corn silage group compared to the untreated corn silage group (3.65 and 8.28 *vs.* 3.5 and 8.0%, respectively). The corrected fat milk was increased significantly in cattle and buffaloes fed inoculated corn silage with MID/1 compared to the untreated corn silage group (26.3 and 19.5 *vs.* 23.9 and 17.4%, respectively).

Table (3): The milk yield, fat and protein percentage of dairy cattle and buffaloes fed inoculated silage with MID/1.

Item	Experimental groups			
	Dairy cattle		Dairy buffaloes	
	Non-inoculated silage	Inoculated silage	Non-inoculated silage	Inoculated silage
Feed intake (Kg/head/day)	14.75^{c} ±0.64	15.68^{ab} ±0.64	15.21^{b} ±0.64	15.99^{a} ±0.64
Milk yield (Kg/head/day)	25.5^{b} ±0.58	27.8^{a} ±0.58	10.85^{b} ±0.51	11.9^{a} ±0.51
Milk yield (Kg/head/105 days)	1.249^{a} ±0.19	2.919^{a} ±0.19	1.139^{b} ±0.19	2.677^{b} ±0.19
Milk fat (%)	8.28^{a} ±0.15	3.65^{bc} ±0.18	8.0^{ab} ±0.15	3.59^{b} ±0.17
Milk fat (g/head/day)	985.32^{ab} ±84.12	1014.7^{a} ±91.23	868^{d} ±79.56	915.45^{c} ±86.24
Fat corrected milk (CFM, 4% fat)*	19.5^{c} ±0.4	26.3^{a} ±0.25	$.174^{d}$ ±0.4	23.9^{b} ±0.25
Milk protein (%)	3.6^{a} ±0.09	3.00^{b} ±0.09	3.4^{ab} ±0.09	3.00^{b} ±0.09
Milk protein (g)	428^{c} ±52.16	834^{a} ±78.54	369^{d} ±36.22	765^{ab} ±78.33

*a,b and c: means at the same column with different superscripts are significantly (P<0.05) different. *Fat corrected milk (FCM, 4% fat) was calculated using the following equation; FCM = (0.4 × kg of milk yield) + (15 × kg of milk fat yield) according to Gains (1928).*

The economic feasibility of MID/1 inoculant:

In dairy cattle (Table 4), the daily and total feeding costs were 31.89 LE/head/day and 3348.45 LE/head/105 days for the inoculated silage group, compared to 31.88 LE/head/day and 3339 LE/head/105 days for the non-inoculated silage group, respectively. The daily and total feeding costs were increased by 0.09 LE/head/day and 9.45 LE/head/105 days when feeding inoculated silage with DIM/1, respectively, compared to the non-inoculated silage group.

Table (4): Economic feasibility of dairy cattle fed inoculated silage with MID/1 and non-inoculated silage.

Item	Non-inoculated silage group		Inoculated with MID/1 silage group	
	Day	105 days	Day	105 days
Total feed intake (Kg/head)	14.76	1549.80	15.98	1677.9
Concentrate feed mixture (Kg/head)	8.86	930.3	8.59	901.95
Silage (Kg/head)	5.9	619.5	7.39	775.95
Total feed cost (LE/head)	31.80	3339	31.89	3348.45
Variable cost (LE/head)¥	110	11550	110	11550
Total cost (LE/head)	141.8	14889	141.89	14898.45
Economical return of milk				
Milk yield (kg/head)	25.50	2677.50	27.80	2919
Milk return (LE/head)	306.00	32130	333.60	35028
Net milk return (LE/head)♯	164.2	17241	191.71	20129.55
Net economic return from milk = Return of inoculant silage - Return of non-inoculant silage				
Day	191.71 – 164.2= 27.51 LE/head/day			
105 Days	20129.55 - 17241 = 2888.55 LE/head/105 days			

Ingredients prices based on October 2021 prices; concentrate feed mixture= 3.19 LE/kg (corn= 3.5 LE/kg, Soya = 7.0 LE/kg, wheat bran=1.6LE/Kg, hay=1.6 LE/Kg, limestone = 0.9 LE/kg, sodium chloride = 0.3 LE/kg, mixed mineral salts = 5.0 LE/kg), Non-inoculated silage = 0.6 LE/kg, cost of inoculant = 350 LE/50 ton silage (0.007 LE/Kg silage), inoculated silage = 0.607 LE/kg, Milk= 12 LE/Kg milk. Concentrate feed mixture contains; corn 50%, soya 12%, wheat bran 15%, hay 20%, sodium chloride1%, limestone 1.5% and mixed mineral salts 0.5%. ¥The variable cost includes the *rent of an animal pen, veterinary care, electricity, water, equipments consumption and labors. ♯Net return; milk return-total cost.*

The milk yield of cattle that fed inoculated silage with DIM/1 was 27.8 Kg/head/day and 2919 Kg/head/105 days, compared to 25.5 Kg/head/day and 2677.5 Kg/head/105 days for cattle that fed non-inoculated silage. The milk return of cattle fed DIM/1-inoculated silage was 35028 LE/head/105 days, while the milk return of cattle fed non-inoculated silage was 32130 LE/head/105 days. The net economic return was calculated by subtracting the total variable cost for 105 days from the net milk return for 105 days. So, the net return due to fed-inoculated silage was 20129.55 LE/head/105 days. Although, the net return of milk due to fed on non-inoculated silage was 17241 LE/head/105 days.

The dairy buffaloes (Table 5) demonstrated the same pattern, with the inoculated silage group's daily and overall feeding costs being 29.11 LE/head/day and 3056.55 LE/head/105 days, respectively, as compared to 27.81 LE/head/day and 2920.05 LE/head/105 days for the non-inoculated silage group. Feeding inoculated silage with DIM/1 increased the daily and overall feed costs by 1.26 LE/head/day and 132.3 LE/head/105 days, respectively. The milk yield of buffaloes that fed inoculated silage with DIM/1 was 11.9 Kg/head/day and 1249.5 Kg/head/105 days, compared to 10.85 Kg/head/day and 1139.25 Kg/head/105 days for buffaloes that fed non-inoculated silage. The milk return of buffaloes that fed inoculated silage with DIM/1 was 19992.00 LE/head/105 days, compared to 18228.00 LE/head/105 days for buffaloes that fed non-inoculated silage. So, the net return due to feeding on inoculated silage was 5385.45 LE/head/105 days, while, the net return due to fed on non-inoculated silage was 3757.95 LE/head/105 days. On the other hand, the net income from dairy cattle fed inoculated silage was higher by 1035.35 LE/head/105 days compared to dairy buffaloes fed inoculated silage.

Table (5): Economic feasibility of dairy buffaloes fed inoculated silage with MID/1 and non-inoculated silage.

Item	Non-inoculated silage group		Inoculated with MID/1 silage group	
	Day	**105 days**	**Day**	**105 days**
Total feed intake (Kg/head)	15.15	1590.75	16.41	1723.05
Concentrate feed mixture (Kg/head)	8.00	840.00	8.21	862.05
Corn silage (Kg/head)	7.15	750.75	8.20	861.00
Total feed cost (LE/head)	27.81	2920.05	29.11	3056.55
Variable cost (LE/head) ¥	110	11550	110	11550
Total cost (LE/head)	137.81	14475.05	139.11	14606.55
Economical return of milk				
Milk yield (kg/head)	10.85	1139.25	11.90	1249.5
Milk return (LE/head)	173.60	18228.00	190.40	19992.00
Net milk return (LE/head) ♯	35.79	3757.95	51.29	5385.45
Net economic return from milk = Return of inoculant silage - Return of non-inoculant silage				
Day	51.29 - 35.79 = 15.50 LE/head/day			
105 Days	5385.45 - 3757.95 =1627.50 LE/head/105 day			

Ingredients prices based on October 2021 prices; concentrate feed mixture= 3.19 LE/kg (corn= 3.5 LE/kg, Soya = 7.0 LE/kg, wheat bran=1.6LE/Kg, hay=1.6 LE/Kg, limestone = 0.9 LE/kg, sodium chloride = 0.3 LE/kg, mixed mineral salts = 5.0 LE/kg), Non-inoculated silage = 0.6 LE/kg, cost of inoculant = 350 LE/50 ton silage (0.007 LE/Kg silage), inoculated silage = 0.607 LE/kg, Milk= 16 LE/Kg milk. Concentrate feed mixture contains; corn 50%, soya 12%, wheat bran 15%, hay 20%, sodium chloride1%, limestone 1.5% and mixed mineral salts 0.5%. ¥The variable cost includes the rent of an animal pen, veterinary care, electricity, water, equipments consumption and labors. ♯Net return; milk return-total cost.

DISCUSSION

Silage chemical analyses:

Due to its higher yield per unit of land area compared to alternative forages, simplicity of harvest features for preservation, and high energy content, corn silage is the most common source of feed for dairy cows (Erdman *et al.,* 2011). Nowadays, the use of bacterial inoculants is becoming more common in order to produce high-quality silage and ensure that the pH immediately drops to prevent the formation of undesirable microorganisms like clostridia. Clostridia are responsible for the degradation of the proteins into ammonia as well as forming butyric acid. Weinberg *et al.* (2003) investigated the effects of various homofermentative lactic acid bacteria as silage inoculants on aerobic silage stability. They demonstrated the positive effect of the homofermentative lactic acid bacteria as silage inoculants for forming acetic acid, which inhibits spoilage organisms (Cooke, 1995; Rooke, 1991 and Weinberg and Muck, 1996). Wilkinson and Toivonen (2003) reported that the most common type of additive for ensiling has been the inoculation with homofermentative strains of lactic acid bacteria (for example, *Lactobacillus plantarum*). When corn silage was inoculated with homofermentative lactic acid bacteria, silages had high levels of lactic acid, and when heterofermentative lactic acid bacteria were used, silages had high levels of acetic acid (Beck, 1972; Bucher, 1970 and Rooke, 1991). Producing Lactate or acetate in the corn silage resulted in an increase in silage stability and preservation time through their antibacterial actions by penetrating the bacterial plasma membrane through lipophilic, undissociated acid molecules. Lactic acid, with a pKa of 3.86, is a stronger acid than acetic acid, which has a pKa of 4.75. In conditions with low pH values (about pH 3.9-4.0), acetic acid has higher antibacterial activity because a greater portion of the acetate is not dissociated (Danner *et al.*, 2003).

Silage digestion and nutritive value:

Some studies that used inoculants containing lactic acid bacteria (LAB) as silage inoculants have reported improvements in animal performance (Gordon, 1989 and Steen et al. 1989). Weinberg *et al.* (2003 and 2004a and b) explained that this improvement in animal performance may come from the direct effects of using an inoculant in the rumen because *Lactobacillus plantarum* in the silage inoculant may be able to live in the silage and thrive in the rumen. According to Contreras-Govea *et al.* (2011), silage inoculation with various LAB improved *in vitro* ruminal fermentation with regard to ruminal effects. Contreras-Govea *et al.* (2013) observed that *L. plantarum* MTD/1 inoculant improved *in vitro* ruminal fermentation through an increase in ruminal microbial biomass yield *in vitro*, which may have an impact on the *in vivo* digestion of nutrients. The mechanism of action by *L. plantarum* MTD/1 inoculant in the rumen is possibly mediated by a tendency to increase DMI and increased ruminal OM digestibility, especially NDF digestibility (Monteiro *et al.*, 2021). In cows given the inoculated silage, the ruminal apparent digestibility of DM, OM, NDF and ADF increased. The improvement in apparent NDF and ADF digestibility may have contributed to the increased apparent ruminal digestibility of DM and OM. The *L. plantarum* MTD/1 inoculant may raise ruminal pH, which would promote the activity of cellulolytic bacteria in the rumen, according to Weinberg *et al.* (2003). Additionally, it's possible that ruminal bacteria that use lactate as a source of energy will become more prevalent (Jaakkola and Huhtanen, 1989 and Daniel *et al.*, 2013).

Milk yield, fat and protein percentage:

Previous reviews of the improvements in milk production in cows feeding LAB-inoculated silage (Weinberg and Muck, 1996; Kung *et al.*, 2003 and Muck, 2013) have been done. Similar to the increase in milk yield seen in the present investigation, studies using only *L. plantarum* MTD/1 as a silage inoculant found an average increase of 1.2 kg of milk/d for cows consuming the inoculated silages. According to Oliveira *et al.* (2017), silage inoculated with LAB increased milk yield for animals by 0.37 kg/d; these benefits were independent of LAB species, diet, level of milk yield, or LAB inoculant application rate. The mean milk yields per cow in the studies investigated by Kung *et al.* (2003) and Oliveira *et al.* (2017) were only 26.6 and 25.0 kg of milk/d, respectively, which was similar to the milk yield of the current study. The enhanced milk yield for cows and buffaloes that ate inoculated corn silage may be explained by Oliveira *et al.* (2017) observation that the increase in milk yield was associated with an increased DMI, similar to that reported in the present study.

Lactic acid is quickly converted to volatile fatty acids (VFA) in the rumen, mostly to propionate, a major gluconeogenic precursor, whether it comes from the silage or is produced by ruminal bacteria (Dijkstra *et al.*, 2005 and Larsen and Kristensen, 2013). According to Mohammed *et al.* (2012), cows fed inoculated silage tended to have higher total VFA concentrations than the control group, suggesting that the liver receives more ruminal propionate. Because lactate is the second-most crucial gluconeogenic precursor in ruminants, any lactate that is not converted to other organic acids in the rumen may also be absorbed and contribute to milk lactose (Dijkstra *et al.*, 2005 and Larsen and Kristensen, 2013). In the liver, propionate and lactate are both converted to glucose, which the mammary gland may employ to synthesize lactose (Dijkstra *et al.*, 2005).

The economic feasibility of MID/1 inoculant:

The daily and total feeding costs of dairy cattle were increased slightly by 0.09 LE/head/day and 9.45 LE/head/105 days when feeding inoculated silage with DIM/1, respectively, compared to the non-inoculated silage group. This increase was due to an increase in silage feed intake from inoculated silage, which represented 46.25% of total feed intake compared to the non-inoculated silage group (39.97%). The milk yield of cattle that fed inoculated silage with DIM/1 was increased by 4.27% compared to those fed non-inoculated silage (27.8 Kg/head/day and 2919 Kg/head/105 days *vs.* 25.5 Kg/head/day and 2677.5 Kg/head/105 days, respectively). Based on the price of cattle milk (12 LE/Kg), the milk return of cattle fed DIM/1-inoculated silage was 35028 LE/head/105 days compared to 32130 LE/head/105 days for those fed non-inoculated silage. So, the net return after excluded all variable costs was 20129.55 LE/head/105 days for cattle fed inoculated silage, while was 17241 LE/head/105 days for those fed non-inoculated silage. From these figures, we could be observed that there is an increase in the net income by about 2888.55 LE/head/105 days for dairy cattle fed treated silage with DIM/1 compared to those fed non-inoculated silage.

In dairy buffaloes, feeding inoculated silage increased the daily and total feed costs by 1.3 LE/head/day and 136.5 LE/head/105 days, respectively. This increase was due to an increase in silage feed intake from inoculated silage, which represented 49.97% of total feed intake compared to the non-inoculated silage group (47.20%). The milk yield of buffaloes that fed inoculated silage with DIM/1 was increased by 10.12% than those fed non-inoculated silage (11.9 *vs.* 10.85 Kg/head/day, respectively). After 105 days, it could be observed that there is an increase in the net income by about 1627.50 LE/head/105 days for dairy buffaloes-fed treated silage with DIM/1 compared to those fed untreated silage. In comparison between dairy cattle and buffaloes, the net income from dairy cattle fed inoculated silage was higher by 1261.05 LE/head/105 days compared to dairy buffaloes fed inoculated silage. This is due to an increase in the milk yield of dairy cattle (27.80 kg/day) compared to dairy buffaloes (11.90 kg/day).

CONCLUSION

The present results indicated that the inoculated corn silage with DIM/1 was the best in terms of digestibility, nutritive value, and economic feasibility compared to the untreated corn silage for dairy cattle and buffaloes. Based on the current study, it could be recommended that the MID/1 inoculate be used in corn silage production and used in the feeding regime of dairy cattle and buffaloes as a feed replacement to reduce the feed cost and increase the net income from milk yield.

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استخدام لقاح جديد (MID / 1) لتحسين القيمة الغذائية لسيلاج الذرة وتأثيره على إنتاج اللبن للابقار والجاموس المصري

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أجريت هذه الدراسة لتحديد تأثير استخدام الملقح الميكروبي (MID/1) لسيلاج الذره على المأكول اليومي والقيمة الغذائية ومعاملات الهضم وإنتاج اللبن والعائد الاقتصادي الصافي لأنتاج اللبن في الأبقار والجاموس الحلابه. تم استخدام عشرين جاموسه حلابة (متوسط وزن 582 كجم) و 12 بقرة حلابه (متوسط وزن 595 كجم) ، تم تقسيم كلا من الابقار والجاموس بشكل عشوائي إلى مجموعتين متماثلتين. تم تغذية مجموعة المقارنه بسيلاج الذرة غير الملقح والاخري مجموعة السيلاج الملقح (MID/1). تم تقدير معاملات الهضم علي الحيوان باستخدام السيليكا كمرقم داخلي وكذلك تقدير القيمة الغذائية. تم تقدير كمية العلف المأكول. تم تقدير التحاليل الكيميائيه لكل من السيلاج الملقح بالملقح الميكروبي والسيلاج الغير ملقح، حيث تم تقدير الماده الجافة (DM) ، والبروتين الخام (CP) ، والألياف الخام (CF) ، ومستخلص الأثير (EE)، والمستخلص الخالي من النيتروجين (NFE) ، وأحماض اللاكتيت والأسيتيت. تم تسجيل إنتاج الحليب ونسب الدهون والبروتين في لبن الأبقار والجاموس الحلابة. أوضحت النتائج أن التغذية علي السيلاج الملقح بالملقح البكتيري أدت إلي زيادة معنويه في كلا من القيمة الغذائية ومعاملات الهضم لكل من DM، و OM، و CP، و CF، و EE عن تلك التي غذيت علي سيلاج غير المعامل في كلا من الابقار والجاموس الحلاب. زادت إنتاجية اللبن معنوياً بنسبة 8.3٪ للابقار و 8.8٪ للجاموس في المجموعات التي غذيت علي السيلاج الملقح (MID/1) مقارنة بالمجموعة السيلاج غير الملقح (27.8 و 11.9 مقابل 25.5 و 10.85 كجم / رأس / يوم على التوالي) في كلا من الابقار والجاموس الحلابه. زادت نسبة الدهون في اللبن بشكل طفيف في كل من الأبقار والجاموس في المجموعة (MID/1) مقارنة بالمجموعة غير المعالجة (3.65 و 8.28 مقابل 3.5 و 8.0٪ على التوالي). بلغ صافي عائد الأبقار والجاموس في مجموعة (MID/1) الي 20129.55 و 5385.45 جنيه / رأس / 105 أيام على التوالي مقابل 17241 جنيه للابقار و 3757.95 جنيه / رأس / 105 يوم للجاموس في المجموعة غير المعالجة. أشارت النتائج إلى أن سيلاج الذرة الملقح بالملقح الميكروبي (DIM/1) أدى إلى تحسين القيمة الغذائية ومعاملات الهضم وزيادة إنتاجية الحليب وصافي العائد الاقتصادي في الابقار والجاموس الحلابة مقارنة بالمجاميع التي غذيت علي سيلاج الذرة غير الملقح.

الكلمات الداله: *سيلاج الذره، الملقح الميكروبي، تجارب الهضم، إنتاج اللبن، الابقار الحلابه، الجاموس الحلاب.*