American-Eurasian J. Agric. & Environ. Sci., 5 (6): 838-842, 2009
ISSN 1818-6769


# Improving Productive Efficiency of Lactating Buffaloes Fed Whole Corn Silage

*M.A. Hanafy, M.A. Ali, M.H. Abd El-Gawad, M.S. Farghaly and H.M. El-Banna*

Department of Animal Production, Faculty of Agriculture, Cairo University, Giza, Egypt

**Abstract:** Sixteen lactating buffaloes weighed 600 kg in average and in mid-lactation period, were selected according to its lactation season (2nd and 3rd lactation seasons) and milk yield to study the effect of replacing whole clover and/or a part of concentrate feed mixture (CFM) with whole corn silage without or with some additives (yeast culture or chelated minerals) in dairy buffaloes rations on the performance of milk production. Animals were randomly assigned to four groups (four animals each) to evaluate the impact of feeding tested rations for three months on the milk production efficiency. Whole corn plants were chopped (1-1.5 cm) and ensiled in double-layer bags (150x75 cm) for 60 days. Chemical changes in silage during fermentation period were determined biweekly. The experimental rations were:

G1 (control): 30 kg clover (5 % of live body weight) + CFM (1kg /1kg milk) + rice straw (*ad lib.*).
G2: 15 kg whole corn silage (1 Kg silage = 2 Kg clover) + CFM (1kg /1kg milk) + rice straw (*ad lib.*).
G3: 15 kg whole corn silage + CFM (0.75 kg /1 kg milk) + rice straw (*ad lib.*) + 15 g yeast (*Saccharomyces cerevisiae*) /h. /d.
G4: 15 kg whole corn silage + CFM (0.75 kg /1 kg milk) + rice straw (*ad lib.*) +10 $cm^3$ biophos, (commercial product as a source of chelated minerals) / 1L drinking water.

Data indicated that silage reached pH 4 after 45 days fermentation period so, it could be suitable for practical feeding. The highest nutrient digestibilities were observed in animals fed G3 followed by those fed G4, G2 and then G1. The highest nutritive value as TDN was observed with G3 (70.91%) compared to 59.65, 65.21 and 67.95 for G1, G2 and G4, respectively. There was a significant increase in milk yield by 22.4 and 14.5% for G3 and G4 compared with G1, while, there was no significant difference between G1 and G2. The same trend was observed for fat, crude protein and solids not fat but these differences were not significant. So, it could be concluded that whole corn silage with either yeast or chleated minerals may replaced the all of clover and a part of concentrate feed mixture in dairy buffaloes rations.1

**Key words:** Corn silage · Dairy · Buffaloes · Digestibility and milk production

## INTRODUCTION

Decrease the cultivation area of clover to increase the cultivation area of wheat, is consider one of the most important objectives of Ministry of Agriculture. But to achieve this objective the problem of animal feeds shortage must be solved, especially for the small holders, whereas more than 90% of buffaloes number in Egypt. Using whole corn silage – based diet for buffaloes feeding may be participate in solving this problem and encourage the small holders to sustain and develop the animal production. Corn silage is considered high-quality forage for feeding animals in many dairy farms. Moreover, application of some feeding techniques such as using some biological or mineral mixtures as feed additives for corn silage may be help to decrease feeding costs as a result of decreasing concentrate consumption, increasing both of feed efficiency and milk production (quality and quantity) and improving the reproductive performance of lactating buffaloes. Yeast culture (YC) as a biological additive showed improvements in feed intake and nutrients digestion [1-3] and milk production and composition [4-6]. On the other hand, using chelated minerals in dairy cattle rations may improve their production performance. Cheling minerals it more bio-available and useful to the body. In many cases, chelated minerals are about 40% more efficient regards to absorption and assimilation into the body than metallic minerals [7].

**Corresponding Author:** Dr. M.A. Hanafy, Animal Production Department, Faculty of Agriculture, Cairo University, Giza, Egypt

So, this experiment was aimed to evaluate the effect of replacing 100% clover and/or a part of concentrate with whole corn silage without or with some additives (yeast culture or chelated minerals) in dairy buffaloes rations.

## MATERIALS AND METHODS

This study was carried out at the Agriculture Experimental and Research Station, Faculty of Agriculture, Cairo University, Egypt.

**Ensiling Procedures and Silage Quality:** Whole corn plants at doughy stage of maturity were chopped (1-1.5 cm length) via chopping machine and ensiled in double-layer plastic bags (150x75 cm) for 60 days. Samples from ensiled materials were taken every two weeks to study the changes of silage quality. Silage samples (25 g) were homogenized with 100 ml distilled water for 10 min. using blender [8]. The homogenized materials were filtered through four layers of cheese cloth, then the filtrates were used for measuring pH using pH meter, ammonia nitrogen by Kjeldahl method and lactic acid according to the method of Analytical Chemistry of Foods [9].

**Experimental Animals and Rations:** Sixteen lactating buffaloes in mid-lactation period and weighed 600 kg in average,, were selected according to its lactation season (in 2nd and 3rd lactation seasons) and milk yield, then housed in separated pens. Animals were randomly assigned to four groups (four animals each) to receive one of the following experimental rations:

G1 (control): 30 kg clover (5 % of live body weight) + CFM (1kg /1kg milk) + rice straw (*ad lib.*).
G2: 15 kg whole corn silage (1 Kg silage = 2 Kg clover) + CFM (1kg /1kg milk) + rice straw (*ad lib.*).
G3: 15 kg whole corn silage + CFM (0.75 kg /1 kg milk) + rice straw (*ad lib.*) + 15 g yeast (*Saccharomyces cerevisiae*) /h./d.
G4: 15 kg whole corn silage + CFM (0.75 kg /1 kg milk) + rice straw (*ad lib.*)+10 $cm^3$ Biophos (local commercial product as a source of chelated minerals)/ 1L drinking water.

Chemical composition of experimental feeds and rations are shown in Table (1). The amount of CFM, consists of 20% undecortecated cotton seeds meal, 3% soybean meal, 34% wheat bran, 40% corn, 2% calcium carbonate and 1% salt, was adjusted biweekly according to milk production and offered twice daily after milking at 8.0 a.m. and 4.0 p.m. while, clover or corn silage were offered from 11.0 a.m. to 2.0 p.m.. Animals fed corn silage were received sodium bicarbonate at 1% of total dry matter intake. Fresh water was available at all times. The daily feeds offered and orts were recorded for each group.

**Milk Recording, Sampling and Analysis:** Buffaloes were hand milking twice daily at 8.0 a.m. and 4.0 p.m. and daily milk yield was individually recorded and corrected to 4% fat milk (FCM) according to Gaines[10]. Milk samples were individually collected biweekly from each buffalo at the two milking times, then samples were composted. Chemical analysis of milk fat, protein, solid non fat, total solid and ash were determined using milkoscan apparatus. Milk fat percentage was determined according to Gerber's method as described by Ling [11].

**Digestion Trials:** At the end of lactation trial nutrients digestibility were determined via acid insoluble ash (AIA) technique as described by Van Keulen and young [12]. Whereas, fecal rectum samples were collected for four successive days from each animal. Samples of feeds and feces were dried in air oven at 70°C over night, then dried at 105°C to a constant weight and ground to pass through 1-mm screen sieve for later chemical analysis.

**Chemical and Statistical Analysis:** Feeds and feces were analyzed for dry matter, ash, crude protein, ether extract and crude fiber according to AOAC [13]. Nitrogen free extract was calculated by difference.

Data were analyzed statistically using the general linear model procedure of SAS [14]. Significant differences between means were separated by multiple range tests [15].

## RESULTS AND DISCUSSION

Data of chemical composition (Table 1) indicated that there was a decrease in the crude protein content in G2, G3 and G4 compared with G1, being 12.00, 11.85, 11.34 and 15.32%, respectively. This decrease was a result of replacing whole corn silage (8.88% CP) instead of clover (17.89% CP) or concentrate (15.65% CP). The NFE content was higher in G2, G3 and G4 compared with G1 as a result of higher content of NFE in whole corn silage than that in clover and concentrate, being 55.93, 55.70, 55.26 and 50.57%, respectively.

Table 1: Chemical composition of experimental feeds and rations (as DM basis)

| | Chemical composition | | | | | |
|---|---|---|---|---|---|---|
| Items | OM | CP | EE | CF | NFE | Ash |
| Experimental feeds: | | | | | | |
| CFM | 90.98 | 15.65 | 2.74 | 12.48 | 60.38 | 9.02 |
| RS | 84.90 | 3.95 | 1.75 | 39.67 | 39.62 | 15.10 |
| C | 88.51 | 17.89 | 3.87 | 29.25 | 37.50 | 11.49 |
| WCS | 91.61 | 8.88 | 2.56 | 24.91 | 55.26 | 8.39 |
| *Experimental rations | | | | | | |
| G1 | 89.58 | 15.32 | 3.02 | 20.92 | 50.57 | 10.42 |
| G2 | 90.39 | 12.00 | 2.56 | 19.90 | 55.93 | 9.61 |
| G3 | 90.32 | 11.85 | 2.55 | 20.22 | 55.70 | 9.68 |
| G4 | 90.40 | 11.34 | 2.52 | 21.28 | 55.26 | 9.60 |

CFM: Concentrate feed mixture RS: Rice straw C: Clover WCS: Whole corn silage.

*Calculated

Table 2: Changes of silage characteristics during 60 days fermentation period

| Ensiling period (days) | Items | | |
|---|---|---|---|
| | pH | $NH_3$ mg/100g | Lactic mg/100g |
| 0 | 5.9 | 0.17 | 4.56 |
| 15 | 4.4 | 0.19 | 4.45 |
| 30 | 4.1 | 0.20 | 4.13 |
| 45 | 4.0 | 0.12 | 3.73 |
| 60 | 4.0 | 0.13 | 3.74 |

Table 3: Digestion coefficients and nutritive values of the experimental rations

| | Experimental rations | | | |
|---|---|---|---|---|
| Items | G1 | G2 | G3 | G4 |
| Digestion coefficients, % | | | | |
| OM | $60.69^{c}$ | $66.56^{b}$ | $70.33^{a}$ | $67.32^{b}$ |
| CP | $55.57^{d}$ | $65.55^{c}$ | $70.52^{ab}$ | $67.99^{bc}$ |
| EE | $63.83^{b}$ | $78.83^{a}$ | $80.99^{a}$ | $79.98^{a}$ |
| CF | $52.20^{d}$ | $60.18^{c}$ | $69.89^{a}$ | $65.34^{b}$ |
| NFE | $71.18^{c}$ | $73.18^{bc}$ | $78.41^{ab}$ | $75.38^{b}$ |
| Nutritive values, % | | | | |
| TDN | $59.76^{c}$ | $65.31^{b}$ | $70.81^{a}$ | $67.80^{b}$ |
| DCP | 8.51 | 7.87 | 8.36 | 7.71 |

a,b, c Means on the same row with different superscripts are significantly different (P<0.05).

Data in Table 2 showed that the best silage characteristics were observed after 45 days of fermentation, being 4.0 pH, 0.12 mg $NH_3$ / 100 g silage and 3.73 mg lactic acid/100 g silage. These results are in agreement with the finding of Khinizy *et al*. [16], Broderick *et al*. [17] and Khalili *et al*. [18].

Data concerning nutrients digestibility and nutritive value (Table, 3) of the experimental rations showed significant (P<0.05) increases of nutrients digestibility in G2, G3 and G4 compared with G1. However, there was insignificant (P<0.05) increases in the digestibility of NFE for G2 compared with G1. There were significant (P<0.05) differences among G2, G3 and G4 in the nutrients digestibility except the digestibility of NFE. The highest nutrients digestibility were observed in G3, being 70.33, 70.52, 80.99, 69.89 and 78.41% for OM, CP, EE, CF and NFE, respectively. The higher digestibilities for silage rations (G2, G3 and G4) may be due to their high easily fermented components and its low content of ash compared with G1. This data is in agreement with the finding of Krajcarski-Hunt *et al*. [19]. The improvement of nutrients digestibility for G3 may be due to that the fermentation activity of bacteria, especially the cellulolytic strains, was increased by YC adding [20-22]. These results are in agreement with Allam *et al*. [5] that digestion coefficients of all nutrients of goats fed YC ration were higher than those in control animals.

Data in the same table indicated that there was a significant (P<0.05) improvement in the nutritive value as TDN by 9.29, 18.49 and 13.45% for G2, G3 and G4, respectively compared with control. This result may be regarded to the improvement of nutrients digestibility. While, there was a decrease in the nutritive value as DCP in G2, G3 and G4 compared with control, being 7.87, 8.36, 7.71 and 8.51%, respectively. This result may be due to the low protein content in these groups compared with control.

Table 4: Feed intake, feed conversion, milk production and composition of dairy buffaloes fed the experimental rations

| Items | Experimental rations | | | |
|---|---|---|---|---|
| | G1 | G2 | G3* | G4** |
| A) Dry matter intake, kg/h/d. | | | | |
| Concentrate feed mixture | 7.88 | 8.88 | 8.59 | 6.77 |
| Clover | 4.50 | --- | --- | --- |
| Whole corn silage | --- | 5.25 | 5.25 | 5.25 |
| Rice straw | 1.25 | 2.00 | 2.15 | 2.20 |
| Total | 13.63 | 16.13 | 15.99 | 14.22 |
| B) TDN intake, kg/h/d. | 8.15 | 10.53 | 11.32 | 9.64 |
| C) Milk yield | | | | |
| Actual milk kg/h/d. | 8.76 c | 9.87 b | 10.72 a | 10.03 b |
| FCM (4 % fat), kg/h/d. | 12.71 c | 14.28 b | 16.22 a | 15.06 b |
| D) Milk composition, % | | | | |
| Fat | 7.01 | 6.98 | 7.40 | 7.35 |
| Protein | 4.28 | 4.28 | 5.03 | 4.32 |
| SNF | 10.04 | 10.05 | 10.09 | 10.02 |
| TS | 17.05 | 17.03 | 17.49 | 17.37 |
| Ash | 0.72 | 0.71 | 0.71 | 0.71 |
| E) Feed conversion, intake/ production | | | | |
| Kg TDN/ Kg FCM | 0.64 | 0.74 | 0.69 | 0.64 |
| F) Feed cost / 1 kg FCM | 1.74 | 1.71 | 1.55 | 2.25 |

a,b, c Means on the same row with different superscripts are significantly different (P<0.05).

* 15 g yeast/h/d. were offered.

** 10 ml from biophos /1 L drinking water were used, each 1 litter of biophos contained 250 g $P_2O_5$, 105 g dicalcium phosphate, 110g di magnesium phosphate, 46 g di sodium phosphate, 20 g di potassium phosphate, 15 g di ferries phosphate, 12 g di manganese phosphate, 11 g di zinc phosphate 26 g di copper phosphate and 120 mg di cobalt phosphate and 5% glucose solution as carrier material.

The prices were: CFM, 2000, Clover, 200, Whole corn silage, 300, Rice straw, 100 (LE/ ton),

Yeast, 25 L.E./Kg, Chelated minerals,20 L.E./litter.

## Performance of Lactating Buffaloes

**1) Feed Intake:** Results in Table, 4, showed that DM and TDN intake were increased by 18.34 and 29.2%, respectively for animals fed G2 compared with G1. This data is in agreement with the finding of Kim *et al*. [23], that dry matter intake of silage by sheep was greater by 17.9% than those fed control ration. Using yeast culture in G3 didn't affect DM intake. This result is in agreement with the finding of Haddad and Goussous [24].While, YC increased TDN intake by 15.5% compared with those fed G2. These increases may be related to that yeast stimulate in rumen microbes, which improved fiber digestion and consequently increased intake as TDN [25]. These results are in agreement with those reported by Abd El-Ghani [26].While; there was a slight decrease in both of DMI and TDN intake for animals in G4 compared with those in G2.

**2) Milk Yield and Milk Composition and Feed Conversion:** There was a significant (P<0.05) increases in the average of actual daily milk and 4% fat corrected milk (FCM) of lactating buffaloes in G2 compared with those in G1, being 9.87 and 14.28 Kg and 8.76 and 12.71 Kg, respectively. These increases may be due to the higher energy content in ration of G2 than G1. These results agree with the findings of Khalili *et al*. [17] and Rego *et al*. [27]. Using yeast in G3 improved daily actual milk and FCM yield by 8.6 and 13.6% compared with G2. While, There was no significant (P<0.05) difference between G2 and G4 regarding average daily milk or FCM production. Increasing milk yield as a result of yeast supplementation may be attributed to that yeast acts as a source of B-beneficial vitamins. The present results are in agreement with those reported by Kholif *et al*. [28] and Alshaikh *et al*. [29]. There were no critical differences in milk composition among the different groups. The best feed conversion was observed in G1and G4 then followed by G3 and G2, being 0.64, 0.64, 0.69 and 0.74 Kg TDN intake / Kg FCM, respectively.

**Economical Evaluation:** The lowest feed cost (as fed) per one kilo gram FCM was recorded in G3 (1.55 LE) while, the highest cost was recorded in G4 (2.25 LE) then 1.74 and 1.71 LE for G1 and G2, respectively.

From the obtained results of this study, it could be concluded that replacing 100% clover and/or a part of concentrate with whole corn silage with yeast culture supplementation may be used for feeding dairy lactating buffaloes.

## REFFERENCES


1. Wohlt, J.E., A.D. Finkelstin and C.H. Chung, 1991. Yeast culture to improve intake, nutrient digestibility performance by dairy cattle during early lactation. J. Dairy Sci., 78: 1395.
2. El-Waziry, A.M., H.E. Kamel and M.H.M. Yacout, 2000.Effect of baker's yeast (*Saccha*romyces *cerevisiae*) supplementation to berseem (*Trifolium alexandriunum*) hay diet on protein digestion and rumen fermentation of sheep. Egyptian J. Nutrition and Feeds, 3: 71.
3. El-Talty, Y.I., G.M. Abdul-Aziz and M.A. Ali, 2001 Calcium hydroxide treatment of organic wastes. 2. Effect on performance of growing goats without or with yeast supplementation. Proc. of the 8th Egyptian J. Nutrition and Feeds Conference, Sharm El-Sheikh, 4: 415.

4. Wallace, R.J., 1996. The mode of action of yeast culture in modifying rumen fermentation. Proc. of Allech's 12th Annual symposium on biotechnology in the feed industry. Nbottinhom Univ. Press, Loughborough, Leics UK.
5. Allam, A.M., K. El-Shazly, B.E.A. Borhami and M.A. Mohamed, 2001. Effect of baker's yeast (*Saccha*romyces *cerevisiae*) supplementation on digestion in sheep and milk response in dairy cows. Egyptian J. Nutrition and Feeds, 4: 315.
6. El-Ashry, M.A., A.M. Kholif, H.A. El-Alamy and T.A. El-Hamamsy, 2001. Effect of different yeast culture supplementation to diet on the productive performance of lactating buffaloes calves. Egyptian J. Nutrition and Feeds, 4: 21.
7. McDowell, L.R., 2003. A Text book of Minerals in animal and human nutrition. 2nd Ed., Elsevier Sci. B.V. Amsterdam, pp: 644.
8. Waldo, D.R. and L.H. Schultz, 1956. Lactic acid production in the rumen. J. Dairy Sci., 39: 1455.
9. Analytical Chemistry of Foods, 1995. Published by Blockie academic and professional, an imprint of Chapman & Hall, Western Cleddens Road, Bishopbriggs, Glasgow G642NZ, UK.
10. Gaines, W.L., 1923. Relation between percentage of fat content and yield of milk. 1- Correction of milk yield for fat content. Agric. Exo. Sta. Bull., 245.
11. Ling, E.R., 1963. A Text Book of Dairy Chemistry. 3th Ed., Vol 11, Chapman and Hall, London.
12. Van Keulen, J. and B.A. Young, 1977. Evaluation of acid insoluble ash as a natural marker in ruminant digestibility studies. J. Anim. Sci., 44: 282.
13. A.O.A.C. 1990. Official Methods of Analysis. 15 th Ed. Association of Official Analytical Chemists Washington, DC., USA.
14. SAS, 1986. SAS Users guide: Version 5 Ed. SAS Institute Inc., Gary, NC.
15. Duncan, D.B., 1955. Multiple Range and Multiple F Test. Biometrics, 11: 1.
16. Khinizy, A.E.M., R.T. Fowad, M.M. Mohy El-Deen, B.M. Badr and A.A.M. Fahmy, 1997. Effect of feeding whole green maize silage with urea molasses minerals mixture on performance of buffaloes calves. Egypt. J. Appl. Sci., 12(8): 408.
17. Broderick, G.A., R.G. Koegel, R.P. Walgenbach and T.J. Kraust, 2003. Ryegrass or alfalfa silage as the dietary forage for lactating dairy cows. J. Dairy Sci., 85: 1894.
18. Khalili, H., A. Sairanen, J. Nousianinen and P. Huhtanen, 2005. Effects of silage made from primary or regrowth grass and protein supplementation on dairy cow performance. Livestock Production Science, 96: 269.
19. Krajcarski-Hunt, H., J.C. Plaizier, J.P. Walton, R. Spratt and B.W. McBride, 2002. Effect of subacute ruminal acidosis on in situ fiber digestion in lactating dairy cows. J. Dairy Sci., 85: 570-573.
20. Wiedmeier, R.D., M.J. Arambel and J.L. Walters, 1987. Effect of yeast culture and *Aspergillus oryzae* fermentation extracts on ruminal characteristics and nutrient digestibility, J. Dairy Sci., 70: 2063.
21. Miller-Webster, T., W.H. Hoover and M. Holt, 2002. Influence of yeast culture on ruminal microbial metabolism in continuous culture. J. Dairy Sci., 85: 2009.
22. Lehloenya, K.V., C.R. Krehbiel, K.J. Mertz, T.G. Rehberger and L.J. Spicer, 2008. Effects of propionibacteria and yeast culture fed to steers on nutrient intake and site and extent of digestion. J. Dairy Sci., 91: 653.
23. Kim, S.C., A.T. Adesogen, J.H. Kim and Y.D. Ko, 2006. Influence of replacing rice straw with wormwood (*Artemisia montama*) silage on feed intake, digestibility and ruminal fermentation characteristics of sheep. Anim. Feed Sci. and Technology, 128: 1.
24. Haddad, S.G. and S.N. Goussous, 2005. Effect of yeast culture supplementation on nutrient intake, digestibility and growth performance of Awassi lambs. Anim. Feed Sci. and Technology, 118: 343.
25. Putnam, D.E. and C.G. Schwab, 1994. Mode of action of yeast culture. J. Anim. Sci., 72: 2-5.
26. Abd El-Ghani, A.A., 2004. Influence of diet supplemented with yeast culture (*Saccharomyses cerevisiae*) on performance of Zaraibi goats. Small Ruminant Research, 52(3): 223.
27. Rego, O.A., S.M.M. Regalo, H.J.D. Rosa, S.P. Alves, A.E.S. Borba, R.J.B. Bessa, A.R.J. Cabrita and A.J.M. Fonseca, 2008. Effects of grass silage and soybean meal supplementation on milk production and milk fatty acid profiles of grazing dairy cows. J. Dairy Sci., 91: 2736.
28. Kholif, A.M., H.A. El-Alamy, M.A. El-Ashry, H.M. El-Sayed and T.A. Ali, 2000. Effect of supplementation of different types of live yeast cultures in the diet on the productive performance of lactating buffaloes. Egypt. J. Dairy Sci., 28: 281-295.
29. Alshaikh, M.A., M.Y. Alsiadi, S.M. Zahran, H.H. Mogawer and T.A. Aalshowime, 2002. Effect of feeding yeast culture from different sources on the performance of lactating Holstein cows in Saudi Arabia. Asian Aust. J. Anim. Sci., 15: 352-356.