EFFECT OF ADDITION OF DIFFERENT LEVELS OF BAKER'S YEAST *SACCHAROMYCES CEREVISAE* ON FERMENTATION QUALITY AND NUTRITIVE VALUE OF ENSILED CORN CROP RESIDUALS

Ali A. Saeed[1] Haitham M. H. Al-Sultani[2] Ameer S. Mottaleb[3]
College of Agriculture/ University of Alqasim Green
[1]aliameensaeed@yahoo.com [2]haitheamm@yahoo.com

Abstract :
An in vitro experiment was carried out at Animal Production Department to study effect of addition of baker's yeast (BY) on fermentation quality of ensiled corn crop residuals (CCR) and its nutritive value. Silage samples were prepared in laboratory with addition of 6 levels of BY, 0, 2.5, 5, 7.5, 10 and 12.5 g/sample. 10% of dates honey (DH) was added as soluble sugars to stimulate silage fermentation. In accordance with CCR levels, silages were labeled CCR_0, $CCR_{2.5}$, CCR_5, $CCR_{7.5}$, CCR_{10} and $CCR_{12.5}$ respectively. Additives were dissolved in quantity of water enough to reduce dry matter content of CCR to about 30-35%. All samples were ensiled for 60 days. Results showed that ensiling had beneficial effect on chemical composition as evidenced by reducing crude fiber (CF) content. Better quality was associated with $CCR_{7.5}$ and $CCR_{12.5}$. Both silages were characterized with greenish yellow color and odor of fermented fruits and lower pH (4.26 vs. 4.21). However, the former attained lower ($P<0.05$) DM loss (9.26 vs. 11.32%) and higher ($P<0.05$) Fleig point (89.22 vs. 85.03). In vitro dry matter digestibility (IVDMD) was improved by ensiling and addition of yeast especially in $CCR_{7.5}$.
Keyword: Corn crop residuals, baker's yeast, honey date, silage

تاثير اضافة مستويات مختلفة من خميرة الخبز في نوعية تخمرات سايلج مخلفات الذرة الصفراء وقيمته الغذائية

علي امين سعيد و هيثم محمد حسين و امير سالم مطلب

الخلاصة :
اجريت دراسة مختبرية في قسم الانتاج الحيواني لدراسة تأثير اضافة خميرة الخبز في نوعية تخمرات سايلج مخلفات محصول الذرة وقيمته الغذائية. حضرت نماذج السايلج في المختبر باضافة 6 مستويات من خميرة الخبز، 0 و 2.5 و 5 و 7.5 و 12.5 غم/نموذج. كما اضيف عسل التمر بمعدل 10% كمصدر للسكريات الذائبة لتشجيع تخمرات السايلج. اذيبت الأضافات بكمية كافية من الماء لخفض محتواه من المادة الجافة الى حوالي 30-35%. خزنت جميع النماذج لمدة 60 يوما. اظهرت النتائج بأن السيلجة كان لها تأثير مفيد في التركيب الكيميائي من خلال خفض المحتوى من الألياف الخام.

ISSN 2072-3875

وقد تحققت افضل نوعية للسايلج عند اضافة الخميرة بمعدل 7.5 و 12.5 غم للنموذج، حيث تميز كلاهما باللون الأصفر المخضر ورائحة الفواكه المتخمرة مع تسجيل اوطأ قيمة للأس الهيدروجيني (4.26 مقابل 4.21). وبالرغم من ذلك فقد سجل النوع الأول اقل (P<0.05) فقد في المادة الجافة (9.26 مقابل 11.32) وأعلى (P<0.05) قيمة فليغ (89.22 مقابل 85.03). وقد حصل تحسن في الهضم المختبري للمادة الجافة نتيجة للسيلجة وأضافة الخميرة وبخاصة عند المستوى 7.5 غم/نموذج.

كلمات مفتاحية: مخلفات محصول الذرة، خميرة الخبز، عسل التمر و السايلج

Introduction :

Silage is forage, crop residues or even agricultural and industrial by-products preserved by acids, in the absence of air (2). Silage and hay are common ways to conserve surplus forages, however silage is considered the better way (8). A forage crop can be cut early and only with low DM content to be ensiled successfully. Hence, there is no need to dry out the plant material any more than that (15). The idea of preservation depends on fermentation of soluble sugars of ensiled materials by anaerobic microbial activity and increase acidity due to production of organic acids especially lactic acid (6). Maximum nutrient preservation in silage is dependent on how rapidly the fermentation is attained. Kung, et. al., (19) reported that prompt reduction in pH obstructs the growth of undesirable anaerobic microorganisms i.e. enterobacteria and clostridia.

Accumulated acids reduce pH value to about 4 or below, at this point, microbes may die and the ensiled material will preserved as long as entry of air is prevented (16). Otherwise, failure of maintaining anaerobic condition will lead to arise of secondary fermentation characterized with aerobic oxidation of organic matter and accumulation of effluents below the ensiled mass. In this undesirable case, less palatable stinky silage may produce with low quality due to increase DM loss (29).

Although field work is required, laboratory silos, however, are still considered a practical method of comparing a number of treatments (25). Therefore, the objective of the study is to investigate the effect of addition of baker's yeast (BY) *Saccharomyces cerevisae* on silage quality, since its activity may help in depletion of oxygen that may remained inside the stored material and improve ensiling condition.

Materials and methods :

Corn crop residuals (CCR) remained in the field after harvesting of cobs was collected from Almusaieb Mashroa, about 40 km northern Babylon Province. These residuals included steams and leaves of corn crop without cobs covers. All these parts were chopped to about 2-5 cm. Dates honey (DH) as a source of soluble sugars was added at rate of 10% on DM basis (1, 27), to stimulate growth and activity of lactic acid bacteria (22, 26). Angel commercial baker's yeast product (BY) was added at 0, 2.5, 5, 7.5, 10 and 12.5g per sample. Chemical composition of ingredients is shown in Table 1. Diluted solution was prepared by dissolving additives in estimated quantity of tap water enough to reduce dry matter (DM) content of CCR to about 30-35% (17). Addition

ISSN 2072-3875

solution was sprayed on chopped CCR, well mixed and 300 g were packed in nylon bags. Bags were compressed tightly and closed firmly. For control silage, CCR was sprayed and mixed with a diluted DH solution without yeast. All 300 g treated CCR containing bags were stored in a pit silo, filled up with soil, well compressed and left with loads on for 60 days during January and February. Sixty days was reported to be the sufficient period for completeness of silage fermentation (27).

Table 1. Chemical composition of ingredient used in making silages

Ingredients	DM	% in DM				
		OM	CF	CP	EE	NFE
CCR	89.21	88.48	32.69	5.68	1.43	48.68
DH	15.72	92.63	0.53	1.39	1.12	89.59
BY	95.12	94.33	-	43.65	-	50.68

CCR, corn crop residuals, HD, dates honey, BY, baker's yeast.
IVDMD of CCR was 62.62%

Sensory characteristic including color, odor and presence of fungi growth were determined as described by Saeed (26). Yellow and brown were considered major colors; graduations of both colors including light and dark in addition to the colors may exist from the interaction between major colors and other colors such as greenish and reddish yellow were used to describe changes in color. Vinegar and fermented fruits with different acuteness were assigned to describe odor of silage samples. Presence and extent of fungi was expressed by – or + signs.

Silage quality was determined according to pH values of silage samples and their Fleig points (Fp), the later were estimated as described by Kilic (18), where the Fp state that values between 85 to 100 signify very good quality; 60 to 80, good quality; 55 to 60, moderate quality; 25 to 40, satisfying quality; and < 20 worthless.

Fleig point = 220 + (2× % Dry Matter -15) – 40 × pH.

As ensiling period was over, bags were collected and transferred to laboratory using isolated boxes provided with ice cubes. Bags were opened successively to determine pH and to perform chemical analysis. Water extracts were prepared as described by Levital, et. al., (21). Where, 100 ml of distilled water was added to 25 g of fresh samples and blended for 10 min, pH values were used immediately in filtrate using pH-meter. Samples of silage were dried in air forced air oven at 60C° for 48 hours. Contents of organic matter (OM), crude fiber (CF), crude protein (CP), ether extract (EE) were determined according to AOAC (2). Nitrogen free extract (NFE) was determined by subtraction. In vitro dry matter digestibility (IVDMD) of silage samples were determined as described by Tilley and Terry (33).

Data were analyzed according to Completely Randomized Design (CRD) design procedure (SAS, 32). Duncan's

ISSN 2072-3875

multiple range tests was used to determine the significance of differences between treatments means (12).

Result and discussion:

Current study was based on fact that removal of oxygen often remained in the ensiled materials help achieving anaerobic condition and high quality fermentation thereafter. Addition of BY may help scavenging trapped air. Accordingly, effect of addition of BY on fermentation quality and nutritive value of CCR silages was studied in relation with chemical composition since it is a criterion of changes may occurred during ensiling (37), and sensory characteristics since it is associated with fermentations of silage. Trulea, et. al., (34) reported that sensorial characteristics are important indicators of silage quality; they considered texture, smell and color as the main characteristics which indicate the quality of silage.

1- Changes in chemical composition

Chemical composition of CCR and CCR silages is shown in Table 2. Results revealed that DM content of silage was not affected by level of BY. This may due to the general effect of addition of DH and completeness of silage fermentation during the 60 days storage. Salih (31) reported that silage fermentation is completed in 60 days as compared with 45 days. No significant changes were occurred when this period was extended to 75 or 90 days. The close relation between levels of soluble sugars in ensiled materials, extent and trend of silage fermentations is well established (10). Moderate ambient temperature during ensiling in a current study may participate in this finding, since it stimulated silage fermentation leading to similar effect on DM loss. DM content of ensiled CCR samples was lower than that of CCR (89.21%). This was expected since water was added at ensiling time. Moreover, Lehtomäki (20) found that DM and OM content of stored crops were in general lower than those of fresh materials. Results showed that addition of yeast caused depression ($P<0.05$) in OM content. There were 3.47, 3.26 and 5.08% decreases in OM content of $CCR_{2.5}$, CCR_5 and $CCR_{7.5}$ as compared with CCR_0, respectively. This may be explained by the formation of volatile fatty acids (VFA) during ensiling as evidenced by significant ($P<0.05$) increase in EE content of silages. Ether extract contents were ranged from 1.33 in control silage to 2-3% in yeast-added silages. These levels were consistent with those reported by Calsamiglia, et. al. (4) for corn silage (3.01 to 2.67-3.01%). Formation and accumulation of VFA is a conclusive concern in making silage. Earlier, Gupta and Pradhan (16) demonstrated that successful ensiling may involve desirable changes stimulating VFA producing fermentations. In a current study, $CCR_{7.5}$ characterized with higher depression in OM accompanied with higher increase in EE content.

ISSN 2072-3875

Table 2. Effect of addition of different levels of baker's yeast on chemical composition of ensiled corn crop residuals (% ± SE)

Corn residuals silages	DM	% in DM				
		OM	CF	CP	EE	NFE
CCR_0	26.63 ± 0.51	87.68 ± 3.25[a]	29.91 ± 1.08[a]	5.22 ± 0.29	1.33 ± 0.05[b]	51.22 ± 2.97
$CCR_{2.5}$	28.89 ± 0.25	84.21 ± 4.64[b]	30.18 ± 2.01[a]	5.23 ± 0.22	2.49 ± 0.08[b]	46.31 ± 3.13
CCR_5	31.43 ± 0.33	84.42 ± 3.51[b]	29.15 ± 0.95[a]	5.36 ± 0.19	2.26 ± 0.09[b]	47.65 ± 2.81
$CCR_{7.5}$	27.31 ± 0.38	82.60 ± 5.44[b]	27.79 ± 1.44[b]	5.42 ± 0.18	3.58 ± 0.08[a]	45.81 ± 2.55
CCR_{10}	29.50 ± 0.40	87.82 ± 4.58[a]	29.83 ± 2.44[a]	5.47 ± 0.20	2.19 ± 0.07[b]	50.33 ± 3.14
$CCR_{12.5}$	24.21 ± 0.30	87.34 ± 4.41[a]	28.25 ± 1.03[b]	5.37 ± 0.34	2.13 ± 0.09[b]	51.59 ± 2.95

CCR_0, $CCR_{2.5}$, CCR_5, $CCR_{7.5}$, CCR_{10} and $CCR_{12.5}$ are corn crop residuals ensiled with 0, 2.5, 5, 7.5, 10 and 12.5 g baker's yeast / sample, respectively.
Vertically different letters refer to significant differences at 0.05

Chemical analysis of ensiled corn residuals samples revealed that crude fiber (CF) content was about 28-30%. Miron, et. al. (23) reported that CF content of silages made from corn crop was below or above 25.8% depending on the stage of harvesting and verities. Results of the current study showed that addition of yeast had positive effect on CF content. This confirmed by the fact that fermentation processes involved partial degradation of cell wall fraction due to activity of silage microbes. Depression in CF content of silages made from equatorial dry roughages had been attributed to the breakdown of cell wall components due to increased vitality of bacterial species that possessed cellulose and hemicellulose activity (6). Kung, et. al., (19) and Nadeau, et. al., (24) have attributed the decline in fiber contents of silage to microbial proteolytic and fibrolytic activities. The same finding was observed by Saeed (27) in wheat straw silage. The addition of soluble sugars in this connection is known to enhance fermentation which subsequently increases cell wall degradation (3). Higher ($P<0.05$) percentage depressions in CF content as compared with CCR (Table 1) were observed in $CCR_{7.5}$ (14.98%) and $CCR_{12.5}$ (13.58%). Saeed (27) reported that 10% of molasses added as fermentable carbohydrates to stimulate silage fermentation may be not enough to maintain the vigor of silage microbes, inducing cellulolytic bacteria to degrade the structural carbohydrate of straw and utilize end products to meet the increased microbial demand for energy. This provide inquiry, whether, addition lower level of soluble carbohydrates may give rise of

ISSN 2072-3875

better effect on mass of structural carbohydrate components. Nevertheless, according to Ohio State experience, it was indicated that addition of molasses at 10-20% of roughage crops (on dry matter basis) improved silage quality and rate of fermentation (36). In Iraq, most studies indicated that 10% of molasses was the preferred level (27, 28; 29, 30, 31).

No significant changes in CP and NFE contents were illustrated from statistical analysis of data obtained in the current study. This may induce a conclusion that good silage fermentations were occurred and no evidence enhances the idea that secondary fermentations were not taken place due to moderate ambient temperature.

2- Changes in sensory characteristics and pH

Table 3 shows observations of sensory characteristics and pH values. Color descriptions indicated that ensiled corn residues made in the current study had been graded between light brown in $CCR_{2.5}$ and CCR_5 and greenish yellow in $CCR_{7.5}$ and $CCR_{12.5}$. This color changes is in agreement with observation of Caluya (5) who reported that during ensiling for 60 days color of silage had been changed from yellow to greenish yellow.

Table 3. Effect of addition of different levels of baker's yeast on sensory and quality characteristics and pH of ensiled corn crop residuals

Corn residuals silages	Color	Smell	Presence of fungi	pH
CCR_0	**Light brown**	**Diluted vinegar**	+	**4.45 ± 0.08**
$CCR_{2.5}$	**Light brown**	**Diluted vinegar**	-	**4.46 ± 0.09**
CCR_5	**Light brown**	**Concentrated vinegar**	-	**4.57 ± 0.07**
$CCR_{7.5}$	**Greenish yellow**	**Fermented fruits**	-	**4.26 ± 0.14**
CCR_{10}	**Dark yellow**	**Diluted vinegar**	+	**4.43 ± 0.08**
$CCR_{12.5}$	**Greenish yellow**	**Fermented fruits**	-	**4.21 ± 0.10**

CCR_0, $CCR_{2.5}$, CCR_5, $CCR_{7.5}$, CCR_{10} and $CCR_{12.5}$ are corn crop residuals ensiled with 0, 2.5, 5, 7.5, 10 and 12.5 g baker's yeast/sample, respectively.

Vertically different letters refer to significant differences at 0.05

Acidic odor was clearly detected and it was highly concentrated in CCR_5, and diluted in $CCR_{2.5}$ and CCR_{10}. Whereas, $CCR_{7.5}$ and $CCR_{12.5}$ were characterized with odor of fermented fruits which may indicates accumulation of lactic acid. This pleasant odor was accompanied with lower pH. Saeed (27) reported that odor of

ISSN 2072-3875

fermented fruits was detected in wheat straw silage due to addition of molasses at rate of 10%. Since soluble sugars were added at similar rate for all silages in a current study, association odor of fermented fruits with $CCR_{7.5}$ and $CCR_{12.5}$ may indicates role of yeast per se.

If observation concerning depression in OM and increase in EE contents of $CCR_{7.5}$ are taken together and considering EE content as an indicator for VFA which unfortunately for technical considerations did not determined in the current study, then the priority will certainly goes towards this silage and the level of yeast added may be the conclusive point.

All CCR silages were well fermented as evidenced by pH values and absence of fungi growth accept CCR_0 and CCR_{10}. Values of pH in a current study were ranged from 4.21 to 4.57 and were almost similar to 4.3 and 4.15 reported by Deswysen, et. al., (11) and Demirel, et. al., (9), respectively. Consequently, pH values recorded in the present study were considered to be in the acceptable range. Statistical analysis revealed no significant effect can be attributed to the addition of BY or its level. This may occur due to addition of soluble sugars at almost high level in case of corn residuals. Yunus, et. al., (38) reported that addition of molasses at 5% was effective enough to stimulate silage fermentation through reducing pH and producing well preserved lactic acid silage.

3- Characteristics of quality and nutritive value

Characteristics of quality and nutritive value are shown in Table 4. Results revealed that lower significant ($P<0.05$) DM loss was estimated in CCR_5 and $CCR_{7.5}$ with clear priority to the second. DM loss in CCR7.5 was 2.93, 2.66, 1.32, 2.01 and 2.06% lower as compared with CCR_0, $CCR_{2.5}$, CCR_5, CCR_{10} and $CCR_{12.5}$ respectively.

Since there were no significant differences in DM content of silages due to addition of BY (Table 2), differences in DM loss may attribute to DM remained in stored material and exposed to fermentation and not to the level of DM content. Lower ($P<0.05$) DM loss observed in $CCR_{7.5}$ may attribute to mode of fermentation occurred in that silage which seemed to be affected by the removal of oxygen at preparation time.

Oxidation in anaerobic condition characterized with lower loss in both DM and OM with a rise of VFA level because in such reactions, 3-C atoms pyruvate produced in glycolysis pathway will be shifted toward formation of alcohols and organic acids (22). DM losses estimated in a current study were within percentages mentioned by Tabacco, et. al., (35). These authors reported that losses in sorghum silages can account for up to 20% of the total stored DM and up to 70% in the peripheral areas and near the sidewalls of the bunkers.

ISSN 2072-3875

Table 4. Effect of addition of different levels of baker's yeast on DM loss Fp and IVDMD of ensiled corn crop residuals

Feed	DM Loss (%)	FP	IVDMD (%)
CCR_0	12.19 ± 0.58[a]	80.26 ± 5.66[c]	65.12 ± 3.55[b]
$CCR_{2.5}$	11.92 ± 0.69[a]	84.38 ± 4.82[b]	64.81 ± 2.95[b]
CCR_5	10.58 ± 0.48[ab]	85.06 ± 4.75[b]	65.83 ± 3.15[ab]
$CCR_{7.5}$	9.26 ± 0.44[b]	89.22 ± 3.89[a]	68.38 ± 3.29[a]
CCR_{10}	11.27 ± 0.64[a]	86.81 ± 4.21[b]	67.98 ± 3.10[a]
$CCR_{12.5}$	11.32 ± 0.54[a]	85.03 ± 4.83[b]	67.45 ± 2.81[a]

CCR_0, $CCR_{2.5}$, CCR_5, $CCR_{7.5}$, CCR_{10} and $CCR_{12.5}$ are corn crop residuals ensiled with 0, 2.5, 5, 7.5, 10 and 12.5 g baker's yeast/sample, respectively. Fp, Fleig points; IVDMD, In vitro dry matter digestibility.

Vertically different letters refer to significant differences at 0.05

Flieg points are considered the most adopted procedure to evaluate silage quality. Results pointed out that addition of BY enhanced this numerical evaluation. The increments were about 4 to 9 points and all silages made with addition of BY were of very good quality (FP>85) according to the Fleig point scale (18). $CCR_{7.5}$ scored ($P<0.05$) higher quality as compared with other CCR silages. This superiority is a result of positive changes in chemical composition and silage fermentation as reflected on DM loss and pH respectively. Cherney and Cherney (7) reported that low fiber silage with a pH <4.2 is considered to be properly ensiled.

Results also showed that IVDMD of CCR was clearly improved by ensiling, improvement ranged from 2.19 - 5.76 units in CCR_0 and $CCR_{7.5}$, respectively. The positive effect of addition of yeast on digestibility of most nutrients in silage made from corn crop residuals was also observed by Elkholy, et. al., (13). This improvement may due to role of these microorganisms in depleting oxygen from the ensiling batch. Guides, et al., (14) attributed that role to the enhancement occurred in the vitality of cellulolytic bacteria.

References :

1. Al-Sultani, H. M. (2016). Effect of Ensiling and Level of Nitrogen on Nutritive Value of Common Reed (*Phragmites communis*). MSc Thesis. Al-Qasim Green University, Iraq.

2. A.O.A.C. (2005). Official Methods of Analysis, Association of Official Analytical Chemists, Washington, D.C.

3. Baytok, E., T. Aksu, M. A. Karsli, and H. Muruz (2005). The effects of formic acid, molasses and inoculant as silage additives on corn silage composition and ruminal fermentation characteristics in sheep. Turkish J. Vet. Anim. Sci. 29:469-474.

4. Calsamiglia, S., B. Hernandez , G.F. Hartnell and R. Phipps. (2007). Effects of corn silage derived from a genetically modified variety containing two transgenes on feed intake, milk production-composition and the absence of detectable transgenic deoxyribonucleic acid in milk in

ISSN 2072-3875

Holstein dairy cows. J. Dairy Sci., 90: 4718.

5. Caluya, R. R. (1995). Tomato and rice straw silage as feed for growing cattle. Livestock and Forage Commodity Review, Iiocos Agriculture and Resources Research and Development Consortium. Don Mariano Marcos Memmorial State University, Bacnotan , La Union, 6 p.

6. Catchpool, V. R. and E.F. Henzell (1971). Silage and silage-making from tropical herbage species. Herbage Abstr. 41: 213.

7. Cherney, J. H., and D. J. R. Cherney (2003). Assessing silage quality. Pages 141–198 in Silage Science and Technology. D.R. Buxton, R. Muck, and J. Harrison, ed. ASA, CSSA, and SSSA, Madison, WI.

8. Danner, H., M. Holzer, E. Mayrhuber, and R. Braun (2003). Acetic acid increases stability of silage under aerobic conditions. Appl. Enviro. Micro. 69, (1): 562–567.

9. Demirel, M., F. Cengiz, S. Çelik and S. Erdogan (2001). A study on degradability in rumen and silage quality of mixture of corn and Hungarian vetch grown in Van ecological conditions. Yüzüncü Yıl University. J. Agric. Sci., 11: 69.

10. Denek, N. and A. Can (2007). Effect of wheat straw and different additives on silage quality and In vitro dry matter digestibility of wet orange pulp. J.Anim.Vet. Adv.6:217.

11. Deswysen, A.G., P. Dutilleud, J.P. Godfrin and W.C. Ellis (1993). Nycterohemeral eating and ruminating patterns in heifers fed grass or corn silage: analysis by finite fourier transform. J. Anim. Sci., 71: 2739.

12. Duncan, D. B. (1955). Multiple Range and Multipl "F" Test. Biometrics, 11:1-12

13. Elkholy, M. E., H. E. Hassanein, M. H. Soliman, W. Eleraky, M.F. Elgamel and D. Ibraheim (2009). Efficacy of feeding ensiled corn crop residues to sheep. Pakistan J. Nut. 8 (12): 1858.

14. Guides, C.M., D. Gonalves, M.A. Rodrigues and A.Dias-Da-Silva (2008). Effect of *sacchromyces cerevisiae* yeast on ruminal fermentation and fiber degradation (maize silage) in cows. Anim. Feed Sci. Technol. 145: 27.

15. Gull, I., R. Demirel, N. Kilicalp, M. Sumerli and H. Kilik (2008). Effect of crop maturity stages on yield, silage chemical composition and in vivo digestibilities of the maize, sorghum and sorghum-sudangrass hybrids grown in sem-arid conditions. J. Anim. Vet. Adv. 7 (8):1021.

16. Gupta, M. L and K. Pradhan (1977). Chemical and biological evaluation of ensiled wheat straw. J. Dairy Sci. 60: 1088.

17. Hamza, A. S., M.M. EL-Shinnawy, M.F. Emara, T. F. Mohammadi, A.M. EL-Shinnawy (2009). Use of different silages as new feed resources for ruminants. Archiva Zootechnica 12: 2, 79.

18. Kilic, A.C. (1984). Silo Yemi. Bilgeham. Basimevi, Izmir. Cited by Denek, N. and A.Can (2007), Effect of wheat straw and different additives on silage quality and In vitro dry matter digestibility of wet orange pulp. J. Anim. Vet. Adv.6:217.

19. Kung, J., L. J. R. Robinson, and J. D. Pesek (2000). Microbial populations, fermentation end products and aerobic stability of corn silage treated with

ISSN 2072-3875

ammonia or a propionic acid based preservative. J. Dairy Sci. 83:1479-1486.

20. Lehtomäki A. (2006). Biogas Production from Energy Crops and Crop Residues. Available at: https://jyx.jyu.fi/dspace/bitstream/handle/123456789/13152/9513925595.pdf?sequenc, verified on 12.03.2010.

21. Levital, T., A.F. Mustafaa, P. Seguinb and G. Lefebvrec (2009). Effects of a propionic acid-based additive on short-term ensiling characteristics of whole plant maize and on dairy cow performance. Anim. Feed Sci. Tech. 152, 21–32.

22. McDonald, P., A. R. Henderson and S. J. Heron (1991). The Biochemistry of Silage. 2nd Edition. Chalcombe publication. PP. 184.

23. Miron, J., E. Zuckerman, G. Adin, R. Solomon, E. Shoshani, M. Nikbachat, Z. A. Yosef, Z.G. Weinberg, Y. Chen and H.I. Ben-Ghedalia. (2007). Comparison of two forage sorghum varieties with corn and the effect of feeding their silages on eating behavior and lactation performance of dairy cows. Anim. Feed Sci. Technol. 139: 23.

24. Nadeau, E. M. G., D. R. Buxton, J. R. Russell, M. J. Allison, and J. W. Young (2000). Enzyme, bacterial inoculant and formic acid effects on silage composition of orchard grass and alfalfa. J. Dairy Sci. 83:1487-1502.

25- O'Kiely, P. (1993). Influence of a partially neutralized blend of aliphatic organic acids on fermentation, effluent production and aerobic stability of autumn grass silage. Irish J. Agric. Food Res. 32:13–26.

26. Saeed, A.A (2015). Effect of addition of baker's yeast *saccharomyces cerevisae* and source of nitrogen on fermentation of reed silage and its nutritive value. Euphrates J. Agric. Sci. 7 (2): 10-24

27. Saeed, A.A. (2012). Effect of addition of urea and ensiling period on the quality and chemical composition of wheat straw silages. Alquadisia J.Agic.Sci. 2 (2): 1-14

28. Saeed, A.A. (2008). Effect of utilization of different levels of nitrogen and readily fermented energy sources on the quality and chemical composition of wheat straw silages .J. Babalon University, 16 (1): 179.

29. Saeed, A.A. and F.A. Latif (2008a). Effect of time of ensiling on the nutritive value of wheat straw treated with urea and molasses. Alquadisia J. Vet. Med.7 (2) 37 (In Arabic).

30. Saeed, A.A. and F.A. Latif (2008b). Effect of ensiling and level of supplementation with concentrate on voluntary intake and digestibility of wheat straw by Arabi lambs. Alquadisia J. Vet. Sci. 7(1) 42.

31. Salih, S.A. (1983). Effect of Ensiling and Urea Treatment on the Nutritive Value of Wheat Straw. MSc. Thesis, University of Basrah, Iraq.

32. SAS. (2010). User's Guide: Statistics, Release Edition. SAS institute Inc., Cary, NC.

33. Tilley, J.M.A. and R.A. Terry (1963). Two stages technique for the in vitro digestion of forage crops. Gr. J. Grassland Soc., 18:104.

34. Trulea, A., T. Vintilă, G. Pop, R. Șumălan and S. Gașpar (2013). Ensiling sweet sorghum and maize stalks as

ISSN 2072-3875

feedstock for renewable energy production. Res. J. Agric. Sci., 45 (3)

35. Tabacco, E., F. Righi, A. Quarantelli and G. Borreani (2011). Dry matter and nutritional losses during aerobic deterioration of corn and sorghum silages as influenced by different lactic acid bacteria inocula. J. Dairy Sci. 94: 1409–1419.

36. Weiss, B. and J. Underwood. (1995). Silage Additives. Ohio State University. AGF-018-92.

37. Woolford, M. K. (1984). The Silage Fermentation. Marcel Dekker. Inc., New York and Basel.

38. Yunus, M., N. Ohba., M. Shimojo., M. Furuse and Y. Masuda. (2000). Effects of Adding urea and molasses on napier grass silage quality. J. Anim. Sci. 13: 1542.

ISSN 2072-3875