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ENSILED RICE STRAW WITH WHOLE SUGAR BEET PLANTS AND THEIR EFFECT ON PERFORMANCE OF LACTATING COWS

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SUMMARY

This study examined the effect of three forms of co-ensiled rice straw (RS) with whole sugar beets (SB) crushed on milk production and constituents of lactating cows. The first type (S1) incorporated immersed corn grains (CG) for 24 h (81.96 kg CG per ton, RS), while the 2nd and 3rd forms (S2 and S2) contained SB instead of 50 and 100% of CG on an energy basis, respectively. Experimental silages were offered ad libitum separately with a concentrate feed mixture on one of the experimental diets, D1, D2, and D3, respectively.

The silage S3 had non-significant (P> 0.05) population of lactic acid bacteria, yeasts and aerobic bacteria compared to other silages. The DM, OM, CP, EE, NFC, and TCH contents of S1 were slightly (P> 0.05) higher than those of S2 and S3, while the opposite was happened with the NDF and ADF contents. The digestibility of CP and EE in all dietary groups did not differ. However, the digestibility of OM, NDF and ADF in the D3 was higher (P< 0.05) than in D1 and D2. Moreover, the D3 group recorded the highest values (P< 0.05) of silage consumption and palatability, while the lowest values for silage refusal were recorded compared to the D1. Milk production, fat corrected milk (FCM), and energy corrected milk (ECM) were (P< 0.05) higher for cows fed D3 compared with D1 and D2. Protein, lactose, and total solids, as well as solids not fat (%), were higher (P<0.05) for D3 than for the other diets except fat% was higher than fed D1.

The feed conversion ratio (FCR) of cows fed diet D3 was better than that of cows fed D1 and D2 diets. Blood constituents remained unchanged and were within normal ranges. In conclusion, co-ensiling RS with the whole SB plant is considered a good method to improve its nutritional value and the performance of dairy cows.

Keywords: *Ensiled rice straw, whole sugar beet, Milk production, Digestibility, Nutritive values.*

INTRODUCTION

Despite the huge production of rice straw (RS) ranging from 2.7 to 8 tons/hectare, the quantities used as animal feed are very small due to their low nutritional value (Oladosu *et al.*, 2016). A large amount of RS is burned directly in the field, causing obvious air pollution. Fiber digestibility is consequential in a diet that includes low-quality roughages that are high in fiber (Nguyen *et al.*, 2020). By increasing fiber digestibility, ruminants can efficiently obtain more additional nutrients from low-quality roughages (Salama *et al.*, 2007). The limited use of rice straw in feeding ruminants is mainly due to its composition of cellulose and lignin, its unbalanced, low nutritional contents, low voluntary intake, and low digestion. Many attempts have been made to increase RS digestibility through the use of various treatments such as urea treatment, and fungus treatment (Nguyen *et al.*, 2020).

Prior studies have shown that rice straw can ensiling, but may not produce high-quality silage due to low water-soluble carbohydrate (WSC, 29.7 g/kg DM) content and high levels of dry matter content (Li *et al.*, 2010). Feeding sugar-based energy sources to livestock may have some metabolic benefits compared to feeding starch-based energy sources, especially at moderate levels (Evans and Messerschmidt, 2017). However, little research has been conducted with ensiling sugar beets; much of the research has utilized sugar beet pulp. Sugar beet contains a considerable amount of unrestricted energy and available energy has been shown to decrease the pH of a silage combination (Poorkasegaran and Yansari, 2014; Oladosu *et al.*, 2016 and Beauchemin, 2006). A rapid drop in pH (3.8–4.0) is the most effective mode of inhibiting the enzymes that degrade protein and fiber throughout the ensiling process (Li *et al.,* 2010; Ni *et al.*, 2018). Moreover, successfully ensiled SB with roughages reduces the negative effects of oxalate in beet leaves (Beauchemin, 2006). whereas Hokama *et al.* (2000) concluded that lactic acid bacteria in silage use oxalate as a carbon source in nutrient-poor media. Consequently, the purpose of this study was to define if sugar beet could be ensiled with rice straw and the impact of ensiling sugar beet on nutrient composition, pH, and aerobic stability. We hypothesized that sugar beet could be effectively added compared to corn grain for ensiling dry rice straw to improve nutrient quality and preservation properties.

MATERIALS AND METHODS

The study was conducted according to a cooperation protocol between the Animal Production Research Institute and the Sugar Crops Research Institute of the Agricultural Research Centre at Sakha Experimental Station (Kafr El-Shaikh Governate, Egypt).

Ingredients and ensiling rice straws:

The used rice straw (RS) was obtained from the supplier merchants of straw, who collect straw from farmers and then chop it to 2-3 cm in length. The whole SB (beet root and tops) was obtained at yield harvest from the Sugar Crops Research Institute at Sakha Agricultural Experiment Station and crashed when making silage by a shredder machine. The control type of ensiled RS was prepared by adding soaked corn grain (CG) (immersed in water for 24 hours), then minced and mixed with RS (S1). The CG was substituted with 50 and 100% by a whole SB on energy basis content (total digestible nutrients, TDN) as a low and high level (S2 and S3) in tested ensiling RS, respectively. A urea solution was prepared: 10 kg of urea and 300 liters of water per ton of RS on a DM basis. Three piles of ensiling RS were conducted as follows: In the 1st pile, ensiled RS included corn grain (S1), consisting of 81.96 kg CG per ton of RS (82.46% DM) with urea solution. In the 2nd pile, ensiled RS included a low level of SB (S2) consisting of, 150 kg from the fresh whole plant of SB plus 40.98 kg CG per ton of RS with urea solution. In the 3rd pile, ensiled RS included a high level of SB (S3) consisting of 300 kg of SB per ton of RS with urea solution. A plastic sheet was spread on a flat and dry ground surface, and all materials were mixed well by hand and, then laid and pressed in a stack by a tractor. The top was covered with plastic and sealed all around with 10 cm of fine soil, then above were placed old tires or any other suitable objects to prevent the top cover from being blown away by the wind. Samples were directly gathered before and after 45 days of ensiling from six different places of each pile individually to represent the pile and, then mixed well to choose a representative sample (about kg). All samples of the experimental silages were stored at -20 °C for the analysis of fermentation quality and chemical analysis.

Animals, feeding and digestibility trials:

Nine mixed multiparous Balady crossbred (Balady × Friesian) cows with a live weight of 404.9 ± 0.891 kg and third season of milk yield (MY, averaged 16 ± 3.0 kg/h/d at the start of the experimental period 7 wks. postpartum) were randomly assigned to the experimental treatments within each of the three blocks. Cows were housed in individual tie stalls, and body weight (BW) was recorded at the beginning of the study and then every week after morning milking, to cover the amounts of concentrated feed prescribed. The experiment was conducted as a replicated 3×3 Latin square design, and the experimental periods lasted 28 days. The three forms of ensiled RS (S1, S2, and S3) were incorporated into three experimental diets, D1, D2, and D3, respectively. Between experimental cycles, all cows were fed a basal diet for 20 days to eliminate the influence of the previous treatment and 8 days as an acclimatization phase. Concentrate feed mixture (CFM) was provided twice daily at milking time, while ensiled RS was provided *ad libitum* after milking, then removed two hours before milking to determine the amounts consumed and refused of ensiled RS. The relative palatability ranking of the experimental silage was determined using indexes calculated according to Obour and Oppong (2015) by dividing the daily consumption (weight) by the total weight of that silage offered and expressed as a percentage, with a potential maximum of 100 (highly palatable) and 0 (totally rejected), while the other classes stood, high (>60%), medium (35-55%), and low palatability (<25%).

The milk yield (MY) of each cow was recorded twice a week at 6:00 a.m. and 5:00 p.m., then composite morning and evening samples were stored at $^{-}$20 °C for chemical analysis. The percentage of 4% fat-corrected milk (FCM) was calculated according to Gaines (1928), and the yield of energy-corrected milk (ECM) was calculated by the formula of Sjaunja *et al.* (1990) for each cow. During the last week of each period, a sample of rectal faeces was collected from each cow for 6 days, twice daily after milking, and kept refrigerated until composite (within cow). Nutrients digestibility was estimated using the acid insoluble ash (AIA) technique as described by Van Keulen and Young (1977) using 2 N HCl. At the end of each experimental cycle, blood samples were withdrawn from the Jugular vein of each animal in the group at 8.00 a.m. before feeding into vacuum tubes. Serum samples were centrifuged at 3000 rpm for 20 min to get the supernatant, then frozen at -20 °C for the next analysis.

Chemical analysis:

The sensory analysis of ensiled RS (color, odor, texture, and moldiness) was inspected and subjectively judged by a panel involving five personnel before commencing the actual evaluation, independently. Ensiled samples were extracted using a 50 g homogenized sample wet with 100 ml distilled water for 30 secs at high speed in the blender (Mixed Countertop Blenders, Co., Fresh, Egypt), then filtered through double layers of cheesecloth. Silage pH was directly measured using the HI-8424 (HANNA Instruments, Woonsocket, RI, USA), then sampled for the microbial count. The remaining was processed and stored at -20 °C for analysis of fermentation products (NH_3-N, lactic acid volatile fatty acids). The microbial count was determined according to Zhang *et al.* (2016). Filtrate ensiled RS samples (25 ml) were held to analyze lactic acid concentration by the methods of James (1995), Ammonia-N (AOAC, 2016), and total short-chain fatty acids (SCFAs) according to Warner (1964). The molar proportions of SCFA's were determined by HPLC (column: Shodex RS Pak KC-811; Showa Denko K.K., Kawasaki, Japan; detector: DAD, 210 nm, SPD-20A; Shimadzu Co., Ltd., Kyoto, Japan; eluent: 3 mmol L^{-1} HClO4, 1·0 mL min^{-1}; temperature: 50 °C). As described by Ranjit and Kung (2000), the population of lactic acid bacteria was counted by plate count incubated at 37 °C for 48 h under anaerobic conditions, while the counting of yeasts and mold was done on a spread-plate of potato dextrose agar acidified with lactic acid (85%). The plates were incubated at 28 ºC, the counting of yeasts was done at 48 h, and the counting mold was done at 96 hours. All the microbiological data were log-transformed. Milk samples were analyzed for content of fat, protein, lactose, solids not fat (SNF), and total solids (TS) by milk SCAN 133 BN Foss Electric, Denmark.

Dry matter recovery (DMR %) of tested ensiled RS was calculated using the equation of Dickerson *et al.* (1991).

$$DMR (\%) = [(EMpo \times DMpo) / (EMc \times DMc)] \times 100$$

Where: DMR = dry matter recovery (%); EMpo = Ensiled mass at pile opening (kg); DMpo = dry matter at silo opening (%); EMc = Ensiled mass at closing (kg); and DMc = dry matter at closing (%).

Frozen samples of ensiled RS and faeces were placed in aluminum trays, dried at 55 °C in an oven until constant weight, and stored in poly-paper bags at 25 °C in a dry, dark place until chemical analysis. Subsequently, the materials of ensiled RS, faeces, and CFM were grounded in a Wiley Mill (1-mm screen; Thomas Scientific, Philadelphia, PA, USA). The chemically analyzed EE, ash, and acid detergent lignin (ADL) using sulfuric acid were measured as described by AOAC (2016); exceptionally, Kjeldahl N was analyzed in fresh samples and calculated as Kjeldahl N × 6.25. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Goering and Van Soest (1970).

The non-fiber carbohydrates (NFC) were derived from the difference between TCH and NDF, and the total carbohydrates (TCH) were calculated using the equation (100-(CP% + EE% + MM%) (Sniffen *et al.*, 1992). The following parameters were measured calorimetrically using commercial kits (Bio Merieux 69280 Marcy-1, Etoile, France®): total protein (REF-30 115), albumin (REF-20 050), blood urea nitrogen (BUN, E-BC-K183-M), glucose (REF-61 269), alanine transaminase (ALT, REF-22 226), aspartate transaminase (AST, REF-22 226), and creatinine (REF-30 421). Albumin was subtracted from the total protein concentration to get the serum globulin concentration.

Statistical analysis:

A simultaneous Three-Latin squares design was used for statistical analysis. Averages for each period and treatment combination were analyzed to determine the fixed effects of a square, period (P), diet (T), and their interaction (T×P), and the random effects of cow within a square using the mixed model procedures of SAS (2009).

$$Y_{ijkl}=\mu+ B_i+ P_j+ T_k(B)_i+ D_l+\varepsilon_{ijkl}$$

Where Y_{ijkl} is the dependent variable, μ is the mean of all observations, B_i is the fixed effect of block i, P_j is the fixed effect of period j, $T_k(B)_i$ is the random effect of diet k within block i, D_l is the fixed effect of diet l, and ε_{ijkl} is the normally distributed random residual error with an expected mean (0, σ^2). The least-squares means for all parameters were evaluated, and differences were considered significant at $P\leq0.05$.

RESULTS AND DISCUSSION

Sensory evaluation, fermentation, and microbiology of silages:

Table (1) displays the physicochemical characteristics, fermentation profile, and microbial population count of the studied silages. Sensory evaluations of ensiled RS revealed the greatest quality, with a yellow color, a pleasant odor, and a loose, non-viscous texture. These findings are entirely compatible with the well-fermented silage features suggested by Oladosu *et al.* (2016) and showed total similarity among the various varieties of ensiled RS. According to the findings of Ni *et al.* (2018), who advised that more than 50g/kg of DM content be instructed, the three silages examined are high-quality silage, and the presence of WSC in the ensiled RS verifies fermentation quality. According to Oladosu *et al.* (2016), all experimental silages were categorized as very good silage, because their pH ranged from 3.87 to 3.98. The concentration of lactic acid present and the crop's ability to act as a buffer are the two parameters most closely related to the final pH of silage (Ni *et al.*, 2018). These findings supported the findings of Jahanzad *et al.* (2014), who came to the conclusion that the pH of silage was correlated with its WSC and N levels. Moreover, among the various types of silage studied, the NH_3-N findings were highly comparable. These findings are consistent with earlier research by Beauchemin (2006), who found that silage containing more SB had a lower Ammonia-N level.

On the other hand, the counts of lactic acid bacteria, aerobic bacteria, and yeast are very small and insignificant. No apparent mold was seen during the preservation period in the experimental piles of S1, S2, and S3. While S3 silage had a slightly insignificant lower population of yeast and aerobic bacteria and a slightly higher population of LAB than the other silages, this is consistent with the idea that lactic acid bacteria can inhibit other microorganisms (Abedo, 2006).

Table (1): Fermentation quality of ensiled rice straw containing corn grain that was replaced by a low or high level of sugar beet plant with the addition of urea.

Item	**Experimental Silage**		
	S1	**S2**	**S3**
Color	yellowish	yellowish	Light yellow
Odor	pleasant	pleasant	pleasant
Texture	Loose and non-viscous	Loose and non-viscous	Loose and non-viscous
Fermentation characteristics			
WSC, (%)	5.27	5.71	5.99
pH	3.87	3.94	3.98
Lactic acid, (%DM)	4.69	4.76	4.89
NH_3-N/Total N	0.17	0.14	0.11
Microbiology, (log_{10} cfu /g DM)			
Lactic acid bacteria	7.81	7.86	7.93
Molds	ND	ND	ND
Yeast	2.25	2.11	2.04
Aerobic bacteria	5.34	5.21	5.03

S1= ensiled rice straw including corn grains, S2= ensiled rice straw including a low level of sugar beet, S3= ensiled rice straw including a high level of sugar beet, and WSC= water-soluble carbohydrates, ND= not detected.

Chemical composition of the experimental silages and diets:

Regarding tested silages Table (2), minor differences were established in the proximate analysis, where NDF and ADF slightly elevated with an increased incorporation level of SB in ensiled RS, while the contents of EE, CP, TCH, and NFC% were decreased.

On the other side, the contents of OM, CP, EE, TCH, and NFC were decreased, while NDF and ADF proportions were increased as the level of SB increased. The results of the present study were coherent with typical values reported by Gurbuz and Kaplan (2008) and Beauchemin, (2006) concerning the values of DM, OM, CP, EE, NFC, and TCH contents of sugar beet silage.

The slightly higher content of NDF and ADF for ensiled RS including SB compared with the CG is consistent with a previous statement by Gurbuz and Kaplan (2008), who reported that NDF and ADF were slight increased when SB was incorporated with stalks of a corn hybrid. The content of EE, NFC, and TCH was decreased in a diet containing S3 compared with S1. Dry matter recovery (DMR) diminished slightly with the addition of SB to experimental silage. Further, the higher content of ash in S3 and S2 compared with S1 is presumably due to the high ash content of the SB plants and/or to some soil contamination during harvesting (Evans and Messerschmidt, 2017).

Table (2): Chemical composition of the experimental silages and diets.

Item	Experimental Silages			CFM	Experimental Diets		
	S1	S2	S3		D1	D2	D3
DM	40.70	39.28	38.37	91.42	58.63	56.86	55.79
OM	85.97	85.27	84.92	92.87	89.77	89.39	89.20
CP	7.52	7.48	7.45	15.89	12.13	12.04	11.99
EE	1.44	1.33	1.21	3.05	2.32	2.26	2.20
Ash	14.03	14.73	15.08	7.13	10.23	10.61	10.80
NDF	62.04	62.78	62.94	17.95	37.74	38.48	38.73
ADF	42.9	43.05	43.54	11.29	25.48	25.84	26.18
TCH	77.01	76.49	76.43	73.93	75.31	75.09	75.01
NFC	14.97	13.68	13.32	55.98	37.57	36.61	36.28
DMR (%)	88.61	87.02	85.18	--	--	--	--

Feed intake, digestibility, and nutritive values:

The average BW of the animals was similar among the different groups (Table 3). The silage refused represents 6.94, 3.44, and 1.94% of the feed offered, but, representing 7.46, 3.56, and 1.98% of feed consumption for S1, S2, and S3, respectively. The S3 and S2 feed consumption were significantly (P< 0.05) higher than the feed consumption of S1. The total feed intake of the experimental diets was significantly (P<0.05) higher with diets that contained either S3 than S2 and S1. At the same time, the total feed intake of the diet that contained S3 was significantly (P<0.05) higher compared to a diet containing S2. Differences in DM intake may be due to the palatability and nutritional value of the experimental diets, which could be reflected in increased content of DM, OM, EE, NFC, and TCH with D1 compared to D2 and D3, as well as higher contents of NDF, ADF, and ash in D3 than D1. A similar effect is communicated by Evans and Messerschmidt (2017), who suggested that DMI for lactating cows was increased with feeding SB. A higher DMI of the S3 -containing diet than that of the S2-containing diet might show that high-level incorporation of SB in ensiled RS was preferable to low-level, because ruminants generally prefer sweet-flavored forages. (Gurbuz and Kaplan (2008). The improvement in DMI for the D2 and D3 diets containing S2 and S3, respectively, compared to the S1-containing diet may be due to the improvement in the digestion parameters of these tested diets, as indicated by the results in Table (3), whose indices agree with the results of Beauchemin, (2006).

The digestion coefficients of DM and OM were significantly (P<0.05) higher when fed D3 compared to D1. There was no significant (P> 0.05) difference among groups in CP and EE digestibility. The digestibility coefficients of NDF and ADF were significantly (P<0.05) increased with fed diets D2 and D3 compared to that of D1, nevertheless, the digestibility was increased (P<0.05) with fed diets containing S3 than those containing S2.

The higher digestion coefficients of NDF and ADF with diet D3, which included S3, may be due to higher ruminal degradability; also, the results shown in Table (1) indicated that non-structural carbohydrates (NSC) in the diet did not reduce rumen pH, which is consistent with the results of Clark and Armentano (1997). Moreover, Abedo (2006) stated that the higher NDF and ADF digestibility may be due to the fact that pectin fermentation results in less lactate and a higher acetate-to-propionate ratio without affecting the digestibility of cellulose and hemicellulose. Additionally, three arguments might be made for the higher digestion coefficients of specific elements in D3 compared to D1: First, the greater structural carbohydrate contents of the feed, particularly the pectin compounds, are responsible for the decline in rumen outflow rate (Poorkasegaran and Yansari, 2014). Second, it has been demonstrated that the NDF in sugar beet has a very high cation exchange capacity (Evans and Messerschmidt, 2017), which tends to encourage pH management and a more stable rumen environment. Third, due to the SB's potential for improved the efficiency of utilizing different diet components and microbial N production (Oladosu *et al.,* 2016), because of their adequate protein and energy levels, which made them fully available in the gastrointestinal system (Clark and Armentano, 1997). Similarly, Sorathiya *et al.* (2015) concluded that the NDF in SB has a higher digestibility rate as a partial replacement for green fodder.

Feeding a diet containing S2 and S3 led to a significant (P<0.05) increased in TDN value, compared to those containing S1, while no significant (P<0.05) differences were found in TDN values between the diets containing S2 or S3. The DCP values of a diet containing S2 or S3 were significantly (P<0.05) decreased compared to that containing SCG. Good agreement results were recorded by Abedo (2006) who showed that DM, OM, CP, and CF digestibility and nutritive value as TDN were increased with the use of dried SB pulp in animal diets. Furthermore, Suliman *et al.* (2013) showed the best TDN and DCP values were achieved for a diet containing concentrate feed mixture plus SB tops silage compared with the control diet, which contains CFM plus berseem hay.

Table (3): Bodyweight, feed intake, digestibility, and nutritive values for lactating cows fed different experimental diets.

Items	Experimental Diets			SEM	*P-value*		
	D1	D2	D3		T	P	T*P
Bodyweight (Kg /day)							
Live body weight	404.71	404.90	405.22	0.891	0.92	0.08	0.86
Feed intake, (Kg /day)							
Silage offered	6.48	6.48	6.48	0.014	0.92	0.08	0.86
Silage consumption	6.03[c]	6.26[b]	6.36[a]	0.016	<0.01	0.15	0.90
Relative palatability, (%)	93.07[c]	96.56[b]	98.06[a]	0.198	<0.01	1.00	1.00
Concentrate feed mixture	7.40	7.40	7.41	0.016	0.92	0.08	0.87
Total feed intake	13.43[c]	13.66[b]	13.77[a]	0.029	<0.01	0.07	0.85
Digestion coefficients (%)							
DM	67.97[b]	68.61[ab]	69.26[a]	0.372	0.09	0.59	0.59
OM	70.69[c]	72.61[b]	73.19[a]	0.187	<0.01	0.57	0.29
CP	64.34	64.52	64.69	0.216	0.54	0.53	0.55
EE	75.27	75.25	75.23	0.318	1.00	0.74	0.74
NDF	65.36[c]	67.93[b]	69.64[a]	0.250	<0.01	0.06	0.09
ADF	55.36[c]	57.18[b]	58.45[a]	0.299	<0.01	0.84	0.84
Feeding value (%)							
TDN	65.65[b]	67.03[a]	67.35[a]	0.166	<0.01	0.58	0.30
DCP	8.55[a]	8.28[b]	8.27[b]	0.028	<0.01	0.50	0.53

[a, b and c] *Within rows mean bearing different superscripts differ significantly at P≤0.05.*

Animal performance and milk constituents:

The milk yield (MY), composition, and FCR of the various studied diets are shown in Table (4). Cows given a diet containing S3 had significantly higher MY, FCM, and energy corrected milk (ECM) values than those fed a diets containing S2 and S1 (P<0.05). While the MY, FCM, and ECM values for cows fed D2 and D1 did not differ from one another, the ECM values for feeding D1 were significantly (P<0.05) lower. Increased milk production, fat-corrected milk, and energy-corrected milk for cows fed D3 compared with cows fed D2 or D1 may be attributed to higher DMI, and this is consistent with the results of Clark and Armentano (1997). In a study by Sorathiya *et al.* (2015) they confirmed an increase in daily milk production with no significant difference between cows fed SB or when partially replaced with green fodder.

Table (4): Milk yield, milk composition, and feed conversion ratio for lactating cows fed different experimental diets.

Items	Experimental Diets			SEM	*P-value*		
	D1	D2	D3		T	P	T*P
Milk production (kg /h /d):							
Milk yield, (MY)	16.66[b]	17.05[b]	18.00[a]	0.305	0.02	0.13	0.71
Fat corrected milk, (FCM)	14.43[b]	15.21[b]	16.46[a]	0.308	<0.01	0.75	0.49
Energy corrected milk, (ECM)	13.78[c]	14.73[b]	16.34[a]	0.287	<0.01	0.58	0.63
Milk composition (%):							

Fat	3.12^{b}	3.27^{ab}	3.43^{a}	0.053	<0.01	0.09	0.016
Protein	2.56^{c}	2.78^{b}	3.12^{a}	0.056	<0.01	0.65	0.88
Lactose	4.34^{b}	4.45^{b}	5.13^{a}	0.051	<0.01	0.11	0.85
Total solid	10.79^{c}	11.20^{b}	12.38^{a}	0.056	<0.01	<0.01	<0.01
Solid not fat	7.68^{c}	7.94^{b}	8.95^{a}	0.083	<0.01	0.47	0.94
Feed conversion ratio:							
kg DM intake/kg FCM	0.933^{a}	0.904^{a}	0.840^{b}	0.019	<0.01	0.82	0.50
kg TDN intake /kg FCM	0.614^{a}	0.608^{a}	0.566^{b}	0.013	0.04	0.78	0.41

$^{a, b \text{ and } c}$ *Within rows mean bearing different superscripts differ significantly at P≤0.05.*

When comparing cows fed a diet containing S3 to those provided a diet containing S1, milk fat was found to be significantly (P<0.05) higher in the S3-fed cows, but no significant difference was detected between the diets containing S2 and S3. The high values of milk fat and other milk parameters in a diet containing ensiled RS and SB could be due to the relative lack of protein input and the high content of neutral detergent-soluble fiber, chiefly pectin. Rather than fermentation, pectin produces less lactate and a higher acetate-to-propionate ratio in the rumen (Abedo, 2006).

When compared to the control diet, the milk's protein, total solids, and SNF content were increased when cows fed a diet containing S2 and S3. Milk lactose content was significantly (P<0.05) higher with cows fed a diet containing S3 compared to those fed diet containing S2 and the control diet. When fed cows on D3 as compared to D1 or D2, the values of FCR, which are reported as kg DM/kg FCM and kg TDN/kg FCM, respectively, improved significantly (P<0.05). The values of FCR as kg DM/kg FCM and kg TDN/kg FCM in cows fed diet D3 were 9.99 and 7.94%, respectively, better than cows fed the D1 diet with significantly different values (P<0.05). This improvement in FCR with S3 is related to the improvement in milk production. These results agree with Abedo (2006) that FCR was significantly higher for lambs fed a diet that contained dry SB pulp compared with the control diet.

Biochemical blood parameters:

As shown in Table (5), blood constituents as TP, albumin, globulin, AST, ALT, and urea nitrogen values were not significantly different (P>0.05) among cows' groups that were fed diets containing different forms of ensiled RS. The values of total protein, albumin, globulin, and urea remained unchanged and were within the normal ranges reported in the reference values by Radostitis *et al.* (2000). Moreover, the means values of AST and ALT obtained were within the normal activity range recorded in the blood (78–132 U/L and 11–40 U/L, respectively) for healthy cattle by Ingvartsen (2006) and Silanikove and Tiomkin (2010).

The level of glucose in the cow's blood was increased significantly (*P <0.05*) with the diets containing S2 and S3 compared to the control diet (containing S1). In addition, the level of glucose in the blood was increased significantly (*P <0.05*) when feeding cows diets contained S3 compared to that contained S2. Per contra, the mean values of glucose in groups D3 and D2 of cows were much higher and statistically significant compared with the control group D1, which might be attributed to SB plants, which have more readily hydrolysable sugar content than CG (Oladosu *et al.*, 2016). The plasma glucose values found are contrary to the previously obtained values in lactating dairy cows by Gurbuz and Coskun (2011), which decreased with SB content. The absence of significant differences in the blood serum metabolites (except glucose) of the experimental animals indicates a similarity in terms of the quality and quantity of diet (Ndlovu *et al.*, 2009); thus, all animals had the same good health and nutritional status.

Table (5): Biochemical blood parameters of lactating cows fed different experimental diets.

Item	**Experimental Diets**			**SEM**	***P-value***		
	D1	**D2**	**D3**		**T**	**P**	**T*P**
Total protein, (g /dL)	6.19	6.18	6.19	0.017	0.80	0.66	0.92
Albumin, (g /dL)	3.25	3.25	3.24	0.084	1.00	0.92	0.61
Globulin, (g /dL)	2.94	2.93	2.95	0.070	0.98	0.93	0.54
AST, (IU/ L)	86.92	86.84	86.93	0.598	0.99	1.00	1.00
ALT, (IU /L)	19.22	19.17	19.22	0.162	0.97	0.40	0.30
Urea nitrogen, (mg /dL)	16.73	16.54	16.51	0.158	0.59	0.75	0.73
Glucose, (mg /dL)	65.40^{c}	67.41^{b}	71.13^{a}	0.194	<0.01	1.00	1.00

$^{a, b \text{ and } c}$ *Within rows mean bearing different superscripts differ significantly at P≤0.05.*

CONCLUSION

In conclusion, co-ensiling rice straw with the whole plant of sugar beet leads to a good fermentation that is acceptable to animals, consequently improving consumption. Sugar beet plant addition contributes to overcoming the lack of soluble carbohydrates in rice straw, which affects ensiling fermentation. Co-ensiling whole sugar beet and rice straw as an agricultural residue is a good approach to improving the digestive processes and thus increasing the nutritional value of rice straw and animal performance.

ETHICAL STUDY

The study procedure and ethics were approved by the Care and Research Committees of the Animal Production Research Institute (Code No. APRI/ARC/2-2-2-4-2-9).

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سيلاج قش الأرز مع بنجر السكر الكامل وتأثيرهما على أداء الأبقار الحلابة

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يهدف هذا البحث لدراسة تأثير ثلاثة تركيبات من سيلاج قش الأرز (RS) مع بنجر السكر الكامل المفروم (SB) على إنتاج الحليب ومكوناته في الأبقار الحلوب. النوع الأول (SCS) والذى يقصد بة سيلاج قش الارز والمضاف إلية حبوب الذرة (CG) المغمورة بالماء لمدة 24 ساعة (المضاف بمعدل 81.96 كجم لكل طن قش ارز RS) . بينما إحتوى النوعان الثاني (LSB) والثالث (HSB) من السيلاج على إستبدال 50% و100% على أساس الطاقة من بنجر السكر (SB) محل حبوب الذرة على التوالى. حيث تم تقديم السيلاج المختبر بشكل منفصل مع خليط علف مركز لتكوين ثلاث علائق كالتالى D1 و D2 و D3 على التوالي.

أظهرت النتائج أن السيلاج HSB يحتوى على عدد أكبر من بكتيريا حمض اللاكتيك مقارنة بنوعي السيلاج الأخرى. كانت محتويات DM و OM و CP و EE و NFC و TCH في السيلاج SCG أعلى قليلاً من تلك الموجودة في LSB و HSB ، بينما حدث العكس مع محتويات NDF و ADF و ADL . لم تختلف فى معاملات الهضم لكلا من CP و EE في جميع العلائق الغذائية المختبرة ومع ذلك ، كانت قابلية هضم DM و OM و NDF و ADF في المجموعة D3 أعلى معنويا (P <0.05) فى D1 و D2.

بالاضافة الى ذلك، سجلت مجموعة D3 أعلى قيم معنويا (P <0.05) بالنسبة لاستهلاك السيلاج واستساغتة مقارنة بمجموعة D1. كان إنتاج الحليب والحليب المعدل لنسبة الدهن (FCM) والحليب المعدل للطاقة (ECM) اعلى بصورة معنوية (P < 0.05) فى الابقار التي تغذت على D3 مقارنة بـ D1 و D2. كانت نسبة الدهون والبروتين واللاكتوز والمواد الصلبة الكلية، وكذلك المواد الصلبة غير الدهنية (٪) أعلى (P < 0.05) في المجموعة D3 مقارنة بالمجموعة D1. كانت معاملات تحويل العلف (FCR) للأبقار التي تغذت على النظام الغذائي D3 أفضل من تلك الخاصة بالأبقار التي تتغذى على النظام الغذائي D1. فى حين ظلت قيم مكونات الدم دون تغيير (ماعدا الجلوكوز) وكانت ضمن المعدلات الطبيعية. في الختام، يعتبر سيلاج قش الارز مع بنجر السكر الكامل هى طريقة جيدة لتحسين القيمة الغذائية لقش اللأرز وتحسين الاداء الانتاجى للابقار الحلابة.