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ALTERNATIVE FEED RESOURCE FROM PROCESSED RUMEN CONTENTS IN POST WEANING GROWING BUFFALOE CALVES RATIONS IMPACTS ON NUTRIENTS INTAKE, DIGESTIBILITY, PERFORMANCE, AND SOME RUMEN PARAMETERS.

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ABSTRACT

Fifteen weaned male and female buffalo calves of an average live body weight 90 Kg were randomly assigned to three experimental groups in a trial lasted for 15 months. The control group was fed a basal ration (70 % concentrate feed mixture (CFM) + 30 % rice straw), while the second group T2 was fed a ration contained sun dried rumen contents (SDRC) , and the third group T3 was fed a ration contained ensiled sun dried rumen contents (ERC) to replace 50 % of the control ration concentrate fed mixture (CFM) crude protein content. The results of processing rumen contents(RC) waste showed that the sun curing period of 15 days is the best, which (with covering the material after the $4^{th.}$ day till the 6^{th}. of sun drying with high density polyethylene (HDP) sheet for 48 hrs.) produced a protein content of 16.80 % and dry matter content 90.50 %. Ensiling the partially sun cured rumen contents (ERC) waste lead to increasing the crude protein content up to 19 % of the final silage (90 days age). Results showed significant differences ($P<0.05$) in favor of T2, followed by T3 over the control group for digestible DM, OM, CP, CF, EE, and NFE. Dry matter intake for the T2 was the highest followed by T1 and T3. Crude protein Intake was the highest for T2 followed by T3 and the control. Results showed significant differences ($P<0.05$) in favor of T3 , followed by T2, and the control become last for rumen total volatile fatty acids(TVFA's), total nitrogen (TN), non-protein nitrogen (NPN) and true protein (TP) concentrations in rumen liquor. Feeding calves on SDRC and ERC improved ($P<0.05$) the average daily gain (AVDG) for SDRC and ERC groups followed by the control group. The usage of SDRC or ERC as a feed ingredient in buffalo calves rations did not show any negative effects on the health of the animals and their performance.This study aimed to make a step to test the sun drying and ensiling processes efficiencies in curing RC and evaluating the growing buffalo calves responses through measuring nutrients digestibility and some rumen parameters changes as the processed RC was introduced in their rations. Also, the study aimed to get an economic, acceptable alternative natural feed resource for ruminants.

Keywords: Slaughterhouse waste rumen contents, sun drying, ensiling, buffalo calves, intake, digestibility, rumen, performance.

INTRODUCTION

The animal feed gab in Egypt amounts up to 4.79 million tons of TDN and 715, 000 thousand tons of crude protein. To cover the gab, the government used to import corn which reached 5.5 million tons in 2003 (El-Ashry *et al*., 2007). It is important to point out to the abrupt increasing change in corn, soybeans, other grains and sugar cane due to its use in ethanol and biodiesel production in its producing countries. It is expected for the prices of these feed resources and its co-products to multiply in the very near future. (El- Ashry, 2007).

Now, in Egypt, it is a situation of a must case to search for and find alternative animal feed resources. Utilizing agricultural by-products, poultry house litter, slaughterhouse waste rumen contents as a feed for ruminants after processing and curing employing suitable processing techniques(Khattab *et al*., 2006, El-Ashry, 2007; and El-Nouby, 2007).

The slaughterhouse waste rumen contents (paunch manure) is the last ingested feed diet, which mainly composed of plant concentrates and roughages materials of different qualities combined with minerals, vitamins and other diet additives, by the ruminants and withdrawn from the rumens after animal slaughter. The amount of ruminant compound stomach content depends on the kind of animal slaughtered and substantially on the time of last feeding and kind of last ingested fodder.

The rumen microbial population is very dense. The microbial protein mass consists of bacteria, protozoa, actinomycetes and fungi. These microbes are very specialized to survive and thrive within the rumen where the conditions are strictly anaerobic. Bacteria whose population is between 10^9 and 10^{10} per ml of the rumen contents,rich with electrolytes, composed mainly of strictly anaerobic bacteria and which constitute more than half of the total microbial biomass content. These include many varieties of bacteria depending upon whether they are cellulolytic, amylolytic, proteolytic or ureolytic. Protozoa, above all, anaerobic cilia population is between 10^5 and 10^6 cells per ml of the rumen contents. Anaerobic fungi, more common in tropical than in temperate ruminants, population in tropical ruminants may be of the order of 10^3 per ml of the rumen contents (Beauchemin, 2007), and Chenost and Kayouli (1979)).

The main problem with slaughterhouse waste rumen contents (RC) is that it is a very microbiologically active material contains a lot of different speedy fermentable nutrients. When RC being accumulated, intensively surfacely discharged, disposed, land-filled in on the land, discharged in the water streams, or land-filled, it leaches its soluble minerals such as nitrogen, phosphorous and others to water streams and ground water causing great pollution threat and contamination (Nafarnda *et al*, 2006). It also undergoes uncontrolled fermentation, rots, decays expelling noxious unpleasant odors and gases (CO_2, NH_3, H_2S and methane CH4) in the environment. As a greenhouse gas, methane is more than 20 times as detrimental as carbon dioxide to the ozone layer and to the environment (NTSC 2007) and Moss *et al*., (2000)). Also, it encourages flies, insects, and rodents to reproduce and multiply, making great threat to the people and environment. Also, if it is improperly discharged for long time (routinely) in the crop lands without suitable curing it damages and hurts the plant root rhizosphere area, through depleting and exhausting the oxygen required for the plants roots, (Adesemoye, *et al*., 2006).

The main objectives of this study were (1) To assess the potential of SDRC or the ERC to provide an environmentally friendly alternative methods for handling paunch manure. For eliminating odors and destroying pathogens alternative RC disposal practices (other than land filling) are, anaerobic digestion, composting and deep-stacking as means of processing for energy and fertilizer production. (2) To determine the chemical composition and

nutritive values of rumen contents (RS) as either sun cured rumen contents SDRC, or ensiled partially sun cured rumen contents ERC. (3) To test the effect of including the SDRC or the ERC in the (T2) and (T3), respectively, to replace 50% of the concentrate feed mixture (CFM) crude protein (CP) of the basal control ration, and (4) To test the effect of including the processed rumen contents on the nutrients digestibility, diets nutritive value, the experimental growing buffaloes performance, and some rumen parameters.

MATERIALS AND METHODS

This study, which lasted for 15 months, was carried out at The Milk Replacer Research Center Farm and Animal Production Department, Faculty of Agriculture, Ain Shams University, Shoubra EI-Kheima, Kalubeiah province.

Preparation of sun cured rumen contents (SDRC):

Fresh slaughterhouse waste rumen contents (including both solid and liquid rumen contents) were collected (in plastic 120 liter size drum containers) from the public slaughterhouse of Meet-Nama, Shoubra Alkhaima, Kaluobeiah Provence, immediately after the slaughter of ruminant animals. The collected material batches were transported to the site of processing, spread on plastic sheets in a 10 centimeter depth layer. The processed RC was shuffled upside down twice daily, till complete sun drying for 15 days, sampled and analyzed daily. At the 4 $^{th.}$ day of sun drying, rumen contents layers were covered by plastic sheets for only 48 hours to stop the nutrients breakdown and degradation by house fly larvae present in the material. The sun dried rumen contents were collected in large polyethylene bags till feeding time.

Preparation of ensiled partially sun cured rumen contents (ERC):

At the 6 days from the beginning of rumen contents sun drying, molasses was added at 5% level (wet basis) to the partially dried rumen contents to be ensiled. Batches of 500 Kg RC-molasses mixtures were placed in three concrete silo ditch cells each of two tons capacity. Each silo cell was lined and covered for good insulation with 300 microns thickness high density polyethylene (HDPE) sheets. After a fermentation period of three months, the pens were opened as required .The required quantities of ERC offered to the experimental animals each day were removed freshly from the silo 12 hours before feeding time, and were allowed to aerate. The silo was covered tightly each time till the next silage withdrawal.

Representative samples of RC - molasses mixtures were taken before ensiling resembling the initial mixtures samples. Each of the three ditch silos was opened at 3 months after ensiling for samples withdrawal for evaluation and analysis. Samples (200 g's) of initial and ensiled mixtures were dried at 65 -70°C for 24 hrs., ground and subjected to analysis for chemical composition, other fresh samples (20 g's) of initial and ensiled mixtures from each pen were combined with 80 ml of distilled water and extracted by blending in 300 ml. mason jars and filtered through four layers of cheese cloth. The pH values of samples were measured in the filtrates using a digital pH meter.

Filtrates were acidified with 0.I N H_2S0_4 for analysis of non- protein nitrogen (NPN) and ammonia nitrogen (NH3- N) concentrations.

Experimental animals:

Fifteen weaning male and female buffalo calves after (about 90 days old) of 90 kg live body weight were used. Animals were allotted into three similar groups of five animals each. The experimental groups were randomly assigned to one of the three experimental rations.

Animals were kept under semi open shades and fed individually according to Al- Ashry (1980), to produce 1 kg\head\day. The diet CFM, sun dried rumen contents and partially sun dried rumen contents ERC silage were offered at 8 a.m. while rice straw was fed *ad-lb.* Animals were allowed to drink twice daily, and weighed monthly after a fasting period of 16 hrs.

Rations and rationing:

The three experimental rations were, (1) The control ration group (T1) received the basal diet (70 % concentrate feed mixture (CFM), plus 30 % rice straw), (2) T2, received a ration contained 35 % CFM plus 35 % SDRC plus 30 % rice straw, and (3) T3 which received 35 % CFM plus 35 % ESDRC plus 30 % rice straw, respectively.

The components and chemical composition (dry matter basis) of the experimental rations are shown in Table (1).

Digestibility trials:

Through the experimental period, three digestibility trials were applied (after 5^{th}, 10^{th}, 15^{th} months from the beginning of the experiment) using three male animals from each experimental group. Grab sampling method (Maynard and Loosli, 1957) was used and the acid insoluble ash as internal marker was employed for determining the nutrients digestibility. Feces grab samples and representative samples of the experimental rations were taken twice daily at 8.0 a.m. and 3.0 p.m. for seven successive days. Solutions of 10% H2S04 and 10% formalin each were added to the representative samples, dried in oven at 60°C overnight, till constant weight, then mixed and saved for chemical analysis.

The digestibility coefficient of certain nutrients was calculated according to the following formula (Maynard and Loosli, 1957):

$$\text{Digestibility \%} = \frac{\text{\% indicator in feed}}{\text{\%indicator in feces}} \times \frac{\text{\% nutrient in feces}}{\text{\% Nutrient in feed}} \times 100$$

Rumen liquor sampling:

Three animals from each experimental group (the same animals of the digestibility trials) were used to obtain rumen liquor every month at 0,2,4 and 6 hr post morning feeding (pmf.) About 200 ml volume of rumen liquor was collected from each animal· by aspiration through the esophagus using a stomach tube. The rumen liquor was strained through four layers of cheese cloth, pH and ammonia-N were measured as soon as the rumen liquor was collected before adding any of the preservatives, then samples were centrifuged at 4000 rpm for 30 min. Two ml, toluene and 2 ml's paraffin oil

were added to each sample and then kept frozen (-20°C) till analysis. Rumen liquor pH was determined (freshly before rumen liquor stored) using a pen pH (GENCO) meter. The concentration of ammonia nitrogen in the rumen liquor was determined (fresh rumen liquor before storing) by the Conway method,(1957). Total volatile fatty acids (TVFA's) were determined according to the method of Petroonkina (1961). Total nitrogen and non protein nitrogen were determined by the modified semi micro-Kjeldahl digestion method of A.O.A.C, (1990). True protein was calculated by difference.

Table (1): Effect of processing of rumen contents RC on its chemical composition, (Dry matter basis, DMB, %).

Day	DM	OM	CP	CF	EE	NFE	ASH
Effect of sun drynig:							
1	14.00	86.69	8.85	36.0	2.10	39.74	13.31
2	14.33	86.53	8.90	36.10	2.14	39.39	13.47
3	23.90	85.75	10.39	36.26	2.31	36.79	14.25
4	35.15	85.47	10.99	36.09	2.36	36.03	14.53
5	42.90	84.67	16.60	34.00	2.51	31.56	15.33
6	45.50	84.36	16.89	34.00	2.63	30.84	15.64
7	49.30	84.23	16.88	33.11	2.71	31.53	15.77
8	56.57	83.98	16.80	33.00	2.75	31.43	16.02
9	62.43	83.19	16.70	33.10	2.84	30.55	16.81
10	67.40	83.20	16.80	32.93	2.83	30.64	16.80
11	87.81	82.22	16.80	32.95	3.00	29.47	17.78
12	81.00	84.00	16.81	32.80	2.90	31.49	16.00
13	88.02	83.79	16.80	32.70	2.87	31.42	16.21
14	89.66	83.99	17.00	33.00	2.85	31.14	16.01
15	90.50	83.70	16.80	33.01	2.80	31.09	16.30
Effect of ensiling:							
Initial day 6	45.50	84.36	16.89	34.00	2.63	30.84	15.64
Final day 90	46.60	85.00	19.00	30.50	2.88	32.62	15.00

Chemical analysis:

Rations and feces samples: DM, CP, CF, EE, NFE and ash determinations for air dried ground samples (rations and feces) were carried out according to A.O.A.C (1990).

Statistical analysis:

Two main effects were studied in relation to animal performance, digestibility and blood plasma biochemical analysis data as indicated by the following model:

$$Yijk = \mu + Ai + Bj + (AB)\ ij + eijk$$

Where:

Yijk: is the observation on the k^{th} animal in the i^{th} experimental period.

μ: common effect to all animals. In this model, the constant μ is assumed to represent the population mean.

Ai: a common effect to all animals given i^{th} experimental nutritional treatments I =1 to 5.

Bj: an effect common to all animals during j^{th} experimental period j = 1 to 3.

(AB) ij: an effect particular to ith experimental nutritional treatment and jth experimental periods.

Eijk: is a randomized error of all the unidentified factors that may affect the dependent variables and not included in the model.

In the case of rumen liquor analysis, a time effect (H) was added to the previous model (H = 1 to 4 times of feeding), the first and second order interaction of this parameter with the others were introduced in the model. The effect of the experimental period (Bj) was neglected. In applying to previous models, GLM procedures of S A S (Statistical Analysis Systems, 1998) were used.

The Duncan's new multiple range test was used to test the differences among means (Duncan, 1955).

RESULTS AND DISCUSSION

Processing rumen contents:

Sun drying rumen contents and chemical analysis:

Results of the chemical analysis of the sun drying rumen contents (Table 1) and its representative samples revealed that there is an increasing trend for the DM (646%), that might be due to the reduction of water content because of evaporating effect of sun rays heating as reported by Abdelmawla *et al*., (1997). Also, there are increase in CP (89.8%), EE (33.3%) and ash (22.5%) content as compared to their initial sample, the increase % in these nutrients might be produced from microbial and insect (flies andits larvae) sources produced as the sun warmth helped increase the temperature of the drying RC which activated microorganisms to decompose RC, reproduce and multiply. Also, The drying RC attracted the flies and other insects to feed on tne nutrients present in the RC, lay its ova, hatch and produce larvae that also shared RC decomposition process. On the other hand, OM, CF and NFE exhibited a decrease in content, as %, (-3.5, - 8.1, and -21.8) respectively, which might be due to its consumption by microorganisms, fungi and insect larvae, as required for its nutrition, growth, reproduction and multiplication, (Fleming *et al*., 2004; Veeken *et al*., 2001) during fermentation and drying process taking place,. Crude protein content showed an increasing trend with the drying process, which can be attributed to the increase in the microorganisms populations (bacteria, protozoa, fungi, insects, larvae, and its pupae) growth, and reproduction and multiplication within the drying media of the RC. Also, these microflora might be the reason of increasing the content of ether extract of the SDRC (Khattab *et al*., 2006). The increase of ash content might be a result of the increase of consumption of the organic fractions of the SDRC by the micro flora and insects inhabited the drying material during handling and processing (N. T. S. C., 2007). Sun heat, ultra violet rays along with fermentation products combined together with moisture reduction during sun drying resulted in destruction of pathogenic microorganisms (Abdelmawla, *et al*., 1997). It is suggested that sun drying for 15 days seems to be satisfactory for reducing RC moisture and produce good quality feed alternative.

Ensiling rumen contents and chemical analysis:

The chemical analysis of the ERC (the initial and final ensiled samples) are presented in Table (1). Results exhibited a decrease in the CF (-10.3%) and ash(4.1 %) content of the fermented ERC, while there are increases in the content of CP(12.5%), EE (9.5%), and NFE (5.8%) as % of

the initial samples content. On the other hand, the DM, OM, of the ERC were practically similar as compared to the initial samples just prior to ensiling.

As for the tested rations and their ingredients, the results of the chemical analysis (Table 2) revealed that the processed RC contained CF content, almost, similar to that of rice straw, while its content of CP and EE is higher than CFM and RS. The NFE content of SDRC and ERC is lower than that of CFM and rice straw. The CP content of ERC was higher by about 2.2 % and 5 percentage units than that of the SDRC and CFM. Also, The CF content of ERC and SDRC was 2.2 and 2.4 times that of CFM, respectively. Concerning the experimental rations, the chemical analysis of tested rations contained ERC and SDRC showed higher CF and ash contents, but they had considerably lower NFE content than the control ration. The CP content of rations T2 and T3 was slightly higher than that of control (Table 2).

Table (2): The chemical analysis of tested rations and their ingredients (DMB, %).

ITEM	Ingredients, %				Treatments		
	CFM	SDRC	ERC	Rice straw (RS)	Control T1	SDRC T2	ERC T3
DM	91.31	90.50	46.60	92.60	91.69	91.41	76.05
OM	89.20	83.70	85.00	86.81	88.48	86.56	87.01
CP	14.00	16.80	19.00	2.09	10.43	11.41	12.18
CF	13.75	33.01	30.05	34.98	20.12	26.86	25.82
EE	2.45	2.80	2.88	1.03	2.02	2.15	2.17
ASH	10.80	16.30	15.00	13.19	11.52	13.44	12.99
NFE	59.00	31.09	33.07	48.71	55.91	46.14	46.84

Feed intake and nutrients digestibility of the experimental rations:

Nutrients intake: The effect of the experimental treatments on feed intake are shown in Table (3). The Dry matter intake DMI (Kg/h/d) and crude protein intake CPI (g/h/d) results pointed out to significant values ($P<0.05$) during the 1$^{St.}$ and the 2$^{nd.}$ experimental periods for the SDRC group over both the control and ERC groups. In the 3$^{rd.}$ experimental period the SDRC group was in lead ($P<0.05$) in DMI intake followed by T1 and T3. The overall mean treatment effect on DMI showed that the SDRC group consumed higher amount than the ERC group ($P<0.05$). The overall mean value for the consumption of CP was in favor of the SDRC group ($P<0.05$) over the control group, with no significant difference with T3 group. Results showed a gradual increase in both DMI and CPI with animals get older (period effect), this means that calves rumens were developed and there is a rumen adaptation process is going on (progress in age). The overall period effect mean DMI and CPI intakes (Table 3) revealed that the third period was the highest ($P<0.05$) followed by P2 and P1, respectively. Differences in intakes among periods were significant ($P<0.05$) which may be a result of animals needs to cover increasing animals nutrient requirements as required by their body weights became heavier. These findings are supported by Singer, (1995); Fayed, (1995); Mansour, (1996), and Khattab *et al*., (2006)).

Table (3): The effect of the experimental treatments on feed intake.

Item	Control (T1)	SDRC (T2)	ERC (T3)	Overall means
Period 1:				
DMI(kg/h/d)	3.77[b]	4.05[a]	3.24[b]	3.68[c]
CPI(g/h/d)	393.21[b]	462.11[a]	394.63[b]	416.65[c]
Period 2:				
DMI(kg/h/d)	6.61[b]	7.71[a]	5.93[c]	6.75[b]
CPI(g/h/d)	689.42[b]	879.71[a]	722.27[b]	763.8[b]
Period 3:				
DMI(kg/h/d)	9.62a[b]	10.47[a]	8.44[b]	9.51[a]
CPI(g/h/d)	1003:37[b]	1194.63[a]	1027.99[ab]	1075.33[a]
Overall mean:				
DMI(kg/h/d)	6.67[ab]	7.41[a]	5.87[b]	6.65
CPI(g/h/d)	695.33[b]	845.48[a]	714.96[ab]	751.92

[a, b and c] means of different letters in the same raw are significant , different (p<0.05)
[a, b and c]means of different letters in the same column are significant different (p<0.05).

Nutrients digestibility results Table (4), of experimental rations showed that DM and CP digestibility were higher (P<0.05) for the SDRC diet than both control and the ERC. Also, OM digestibility for T2 was higher (P<0.05) than control (T1) but not the ensiled ERC (T3). As for the ERC group, digestibility coefficient values (Table 4) for the CF, NFE, and the nutritive values, expressed as TDN and digestible crude protein (DCP), were higher (P<0.05) than that for the SDRC and the control diets. These results can be attributed to further effects of processing took place by ensiling which rendered the ERC as a whole and its nutrients to be more acceptable, palatable, and made nutrients more available (Abdelmawla, 1997) for utilization by the growing calves. The improvements in nutrients digestibility of the rations in T2 and T3 may also probably due to the fact that the RC is a semi-digested material, and to other factors of microbial origin (its content of different microbial enzymes, vitamins, organic acids …etc.) led to enhanced nutrient utilization, more fibrolytic activities (Treather *et al*.,1980; and Khattab *et al*., 1996; Khattab *et al*., 2006). The results concerning the period effect on nutrients digestibility (Table 4) revealed that period 3 was in general superior (P<0.05) to the control for all nutrients.

Table (4): The effect of including SDRC or ERC in calves rations on nutrients digestibility of the experimental diets.

Items %	Control (T1)	SDRC (T2)	ERC (T3)	EXPERIMENTAL PERIODS		
				P1	P2	P3
DM	68.48[c]	74.15[a]	72.70[b]	71.30[b]	71.68[b]	72.35[a]
OM	72.35[b]	75.97[a]	73.84[ab]	73.39[b]	74.03[a]	74.74[a]
CP	70.33[c]	76.04[a]	72.64[b]	72.42[b]	73.11[a]	73.48[a]
CF	63.73[c]	72.93[b]	74.84[a]	69.67[b]	70.46[b]	71.37[a]
EE	69.05[b]	73.14[ab]	74.35[a]	71.51[b]	72.22[a]	72.82[a]
NFE	63.10[c]	72.62[b]	73.10[a]	6834[b]	70.23[a]	70.24[a]
TDN	57.15[c]	63.69[b]	64.40[a]			
DP	7.33[c]	8.68[b]	8.85[a]			

[a,b and c] : overall means of different letters in the same row or column are significant ly different (p<0.05) .

Based on the overall means of feed intake, differences in intakes between periods might be a result of the animals digestive system development especially the compound stomach, and the increasein the efficiency of absorption and utilization of nutrient as they get older. These findings are supported by Singer, (1995); Fayed, (1995); Mansour, (1996), and Khattab *et al*., (2006)).

Rumen parameters:

Results of rumen parameters are shown in Table (5). The mean pH values exhibited no significant difference (P<0.05) between SDRC and ERC groups. Also, the mean pH values of SDRC group didn't differ (P<0.05) significantly compared to the control group.

Table (5): The effect of feeding the experimental ration on some rumen parameters values.

Items	Control (T1)	SDRC (T2)	ERC (T3)	Over all means
Sampling time:		**1) pH values.**		
0hr	6.23	6.42	6.96	6.53[a]
2hr	6.14	6.18	6.03	6.11[d]
4hr	6.79	6.46	6.05	6.43 [b]
6hr	6.53	6.12	6.03	6.23[c]
Over all means	6.42[a]	6.29[b]	6.27[b]	
Sampling time:		2) NH3- N concentration (mg/l00 ml).		
0hr	14.74	15.74	17.67	16.05[b]
2hr	15.27	16.86	17.14	16.42[b]
4hr	17.50	18.12	18.91	18.18[a]
6hr	15.49	17.50	19.17	17.38[ab]
Overall means	15.75[c]	17.07[b]	18.22[a]	
Sampling time:		3) TVFA's concentration (meq/l00 ml).		
Ohr	9.28	12.76	15.26	12.43[d]
2hr	9.99	14.19	14.62	12.93[c]
4hr	12.95	15.44	16.85	15.07[b]
6hr	16.78	18.51	19.74	18.34[a]
Overall means	12.25[c]	15.22[b]	16.62[a]	
Sampling time:		4) TN concentration (mg/100ml).		
0hr	47.27	53.34	58.52	53.4[d]
2hr	51.87	56.82	62.98	57.22[c]
4hr	57.08	63.01	77.17	65.76[b]
6hr	64.36	88.90	111.90	88.39[a]
Overall means	55.14[c]	65.52[b]	77.64[a]	
Sampling time		5) NPN concentration (mg/100ml).		
0hr	21.47	21.92	23.18	22.19[d]
2hr	25.09	24.98	33.27	27.78[c]
4hr	29.10	33.44	32.91	31.89[b]
6hr	27.23	31.37	49.52	36.04[a]
Overall means	25.72[c]	27.93[b]	34.72[a]	
Sampling time:		6) TPN concentration (mg/100ml).		
0hr	25.82	31.42	35.:33	30.85[c]
2hr	26.80	31.84	29.70	29.45[d]
4hr	28.02	29.58	44.24	33.95[b]
6hr	37.17	57.52	62.37	52.35[a]
Overall means	29.45[c]	37.59[b]	42.91[a]	

[a, b and c]: means of different letters in the same row or column are significantly different (p<0.05)

The SDRC and ERC groups showed the lowest rumen pH values which were more acidic (P<0.05) than that for the control group. That could be attributed to the higher concentrations of rumen TVFA's than that with control ration. Similar trend has been reported by Khattab *et al*, (2006). The overall mean values of treatment effects on rumen concentrations of NH_3- N (mg/l00 ml), TVFA's (meq./l00 ml), TN (mg/100ml), NPN (mg/100ml), and TPN (mg/100ml) (Table 5) revealed that the ERC group was superior (P<0.05) to the SDRC group. These results are supported by similar findings by Khattab *et al*., (2006), where they fed growing Friesian calves diets containing SDRC at 0, 20, and 40 % of the dietary CP.

As for the effect of sampling time (Digestion process progress) the results in (Table 5) overall mean sampling time for rumen pH showed that the highest (P<0.05) was at 0 hrs the lowest value was at 2 hrs.

Results exhibited that NH_3-N concentration at 4 hrs. pmf. was higher (P<0.05) than at 0 and 2 hrs. without significant difference with that at 6 hrs. pmf. Ammonia libration reached its maximum at the 4 hrs. pmf. which didn't differ than that at 6 hrs. pmf. These results are in accordance with that of Khattab *et al*., (1996) on sheep with SDRC; Khattab *et al*., (2006) with growing Friesian calves on SDRC. Concerning the overall mean values of rumen TVFA's, TN, NPN, and TPN concentrations (Table 5) at 2, 4, and 6 hrs. pmf. followed the same increasing trend. Based on the overall means the highest concentrations of these parameters (P<0.05) were recorded at 6 hrs. pmf. and the lowest (P<0.5) concentrations were at 0 and 2 hrs. pmf. reflecting an increasing ruminal activity with time progress up to 6 hrs. pmf.

The effect of experimental periods on mean values of the rumen parameters are presented in Table (6). In general, results reflected a trend of increase (P<0.05) for, pH, TVFA's, TN, and NPN concentrations (especially for ERC diet pointing out to an increase in the microbial activities with period progress. These results match the fact that as the animals got older, a state of development in rumen structure, function and increase in efficiency of nutrients intake and digestion prevailed, (Khattab *et al*., 2006), although there was no significant difference between P2 and P3 for TVFA's and TN was observed.

Results in Table (7), concerning the effect of feeding the experimental rations on the average daily gains (ADG) showed an increase in daily gain as period progress (as animal gets older). The increase in ADG might be a sum of the increased development of the stomach compound structure, function and efficiency which led to an increased feed intake required to cover the increased nutrient requirements for growth and live body weight gain.

The SDRC group (T2) was superior in ADG compared with T3 and T1 in all experimental periods, which may point out to good quality nutrient content of the ration of this group. Also, results pointed out to an increase in rumen microbial protein production, or that the processing method produced some kind of protected protein by-passed the rumen (Abdelmawla *et al*., 1997). On the other hand, based on the overall mean of ADG the ERC group showed lower, but not significantly different from T2 overall mean ADG. These results can be attributed to the conversion of some SDRC TPN to NPN during silage maturation because of the microbial fermentation activity

during ensiling, especially with silage aging. The control group recorded the lowest overall mean of the ADG (P<0.05).

Table (6): The effect of the experimental periods on mean rumen parameters values.

Items	Control(T1)	SDRC (T2)	ERC(T3)	Over all means
1): pH values:				
Period 1	6.46	6.22	6.16	6.28^{b}
Period 2	6.52	6.25	6.21	6.33^{b}
Period 3	6.30	6.42	6.44	6.39^{a}
2): NH3- N concentration (mg/l00 ml):.				
Period 1	15.15	16.27	17.68	16.38^{c}
Period 2	15.71	17.15	18.32	17.08^{b}
Period 3	16.39	17.75	18.67	17.40^{a}
3): TVFA's concentration (meq/l00 ml):				
Period 1	10.95	13.17	13.90	12.70^{c}
Period 2	12.18	15.32	16.53	14.66^{a}
Period 3	13.63	17.18	19.43	16.37^{a}
4): TN concentration g/100ml):				
Period 1	54.31	62.91	73.14	63.45^{b}
Period 2	56.29	66.14	76.57	66.33^{a}
Period 3	54.83	67.50	83.22	68.52^{a}
5): NPN concentration (mg/100ml):				
Period 1	24.93	25.12	31.42	27.22^{c}
Period 2	25.76	28.51	34.40	29.62^{b}
Period 3	26.27	30.15	38.34	30.86^{a}
6): TPN concentration (mg/100ml).				
Period 1	29.40	37.80	41.71	36.38^{ab}
Period 2	30.56	37.63	42.16	36.86^{a}
Period 3	28.38	37.35	44.86	35.56^{b}

$^{a, b \text{ and } c}$: means of different letters in the same row are significant different (p<0.05)

$^{a, b \text{ and } c}$: means of different letters in the same column are significant different (p<0.05)

Table (7): The effect of feeding the experimental rations on average daily gain Kg/day of growing buffalo calves.

ITEM / TREATMENT	Control (T1)	SDRC (T2)	ERC (T3)
First period:			
Initial wt., Kg	90.1	90.5	89.6
Final wt., Kg	123.08	134.85	130.02
Daily gain, Kg	0.22^{b}	0.30^{a}	0.27^{b}
Second period:			
Initial wt., Kg	123.08	134.85	130.02
Final wt., Kg	206.84	255.94	237.56
Daily gain, Kg	0.56^{c}	0.81^{a}	0.72^{b}
Third period:			
Initial wt., Kg	206.84	255.94	237.56
Final wt., Kg	299.77	354.93	338.0
Daily gain, Kg	0.52^{c}	1.10^{a}	0.86^{b}
Overall means, Kg	0.44^{b}	0.68^{a}	0.60^{ab}

$^{a, b \text{ and } c}$: means of different letters in the same row are significantly different (p<0.05)

$^{a, b \text{ and } c}$: means of different letters in the same column are significantly different (p<0.05).

Feed conversion and economic efficiency:

The results of the average feed conversion efficiency (daily feed consumed/average daily gain) shown in Table (8) indicate that T2 exhibited the best conversion efficiency over both T3 and T1.

Results in (Table 8) for the SDRC group clearly reflected that its relative economic efficiency (%), is superior to the ERC and the control groups, where the SDRC had the highest value (134) followed by the ERC (126), while that for the T1 was (63). The change of relative economic efficiency over the control was in favor of the SDRC group (212.7 %) followed by the ERC group (200 %). These results may possibly be attributed to the high quality characteristics of the SDRC nutrient content that 1) enhanced the development of the calves rumens and increased their efficiency in fermentation, digestion and nutrient absorption, 2) the cheap price of RC compared to the other used feedstuffs and 3) improvements of ADG with SDRC treatments. Khattab *et al*.,(1996) reported that the economic efficiency was increased with increasing the level of SDRC in the lamb ration, and Khattab *et al*.,(2006) using 20% or 40 % of SDRC inn Friesian calves rations.

Table (8): Mean feed intake, animal performance, and the economic efficiency.

ITEM	Control (T1)	SDRC (T2)	ERC (T3)
Feed intake:			
CFM(kg)	5.18	3.11	2.94
RS(kg)	2.09	2.48	2.35
SDRC(kg)	0.0	2.59	0.0
ERC(kg)	0.0	0.0	2.17
Cost of feed consumed(LE/day)[1]	10.06	7.38	6.88
Average daily gain(kg)	0.44	0.68	0.60
Feed conversion efficiency(feed/gain)	22.86	10.29	11.47
Price of daily gain,(DG), (LE/Kg).	6.38	9.86	8.70
Return, LE[2]	-4.18	2.48	1.82
Cost of unit of gain[3]	1.33	0.58	0.62
Relative economic efficiency, (RECEF)[4]	0.63	1.34	1.26
Relative economic efficiency, (RECEF), %[5]	63	134	126
Improvement in RECEF, %.[6]	-	212.7	200

[1]Sum of (price of each ration's ingredient ×its amount consumed/day)
[2]Return=selling price of gain-cost of feed consumed.
[3]Feed cost/ price of gain (LE)
[4]Relative economic efficiency RECEF= price of DG/ cost of feed consumed.
[5]Relative economic efficiency, %= (price of DG/cost of feedconsumed)×100.
[6]Improvement in RECEF= (treatment RECEF, %/T1 RECEF)×100.
CFM price=1800 LE/ton
Rice straw price= 350 LE/ton
SDRC & ERC price=350 LE/ton
DG PRICE=14.5LE/Kg

These results strongly exhibit the high potential of both SDRC and ERC as waste materials enabled the efficiently to replace 50% of the CP of

the calves rations concentrate protein, and try to tolerate with the effects of sharp increasing prices of the corn, soybeans and other conventional feed resources that have been used for bio-fuel production, and alleviate the burdens put on the environment from dumping wastes that undergo uncontrolled decay and rotting when disposed in the open environment.

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تـأثير إسـتخدام بـديل علفـى مـن محتويـات الكـرش المعالجـة فـى علائـق عجـول الجاموس المفطومة على المـأكول وهضم العناصر الغذائيـة والأداء وبعض عوامـل الكرش.

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إستخدم فى هذه الدراسة عدد 15 عجل جاموسى مفطوم من االذكور والإناث بمتوسط وزن حى 90 كجم واستمرت الدراسة 15 شهرا. تم توزيع الحيوانات عشوائيا إلى ثلاث مجموعات المعاملات التجريبية. غذيت كل منها على إحدى العلائق التجريبية الثلاث وهى على الترتيب: T1 مجموعة المقارنة وغذيت على العليقة القاعدية (مكونة من 70 % علف مركز مصنع (ع م م) +30 % قش أرز) ، مجموعة T2 والتى تكونت من العلف المصنع ومحتويات الكرش المجففة شمسيا (م ك م ش)، ثم المجموعة الثالثة T3 وغذيت على العليقة المكونة من العلف المصنع مع سيلاج محتويات الكرش (س م ك) ، (تم إحلال محتويات الكرش المعالجة محل 50 % من محتوى بروتين العلف المصنع فى العليقة القاعدية).

أوضحت نتائج الدراسة على معالجة محتويات كرش المجترات من مخلفات المجازر بالتجفيف الشمسى أو بالتجفيف الشمسى الجزئى ثم السيلجة ، أن التجفيف الشمسى لمدة 15 يوما هو الأفضل (تم تغطية المخلفات أثناء المعالجة بعد اليوم الرابع من التجفيف بمسطحات من رقائق البولى إيثيلين لمدة 48 ساعة) ، حيث أنتج محتوى بروتينى قدره 16.8% ومادة جافة 90.5 %. أدت سيلجة محتويات الكرش المجففة جزئيا فى الشمس إلى زيادة محتوى البروتين الخام إلى 19 % من منتج السيلاج النهائى (عمر 90 يوم) .

أشارت النتائج إلى وجود فرق معنوى ($P<0.05$) لصالح T2 التى غذيت على (م ك م ش) وتبعتها المجموعة الثالثة T3 المغذاة على (س م ك) متفوقتان على المجموعة المقارنة فى هضم العناصر الغذائية.

تفوقت مجموعة T2 فى المأكول الغذائى ($P<0.05$) على مجموعة المقارنة و مجموعة T3 . أظهرت T2 أعلى مأكول ($P<0.05$) من البروتين الخام تلتها مجموعة T2 ثم مجموعة المقارنة .

أوضحت نتائج دراسات الكرش أن T3 أنتجت أعلى تركيزات ($P<0.05$) أحماض دهنية طيارة TVFA's ، والنيتروجين الكلى TN والنيتروجين غير البروتينى NPN والبروتين الحقيقى TP ، تبعتها مجموعات T2 ثم مجموعة المقارنة.

أوضحت النتائج أن تغذية العجول على علائق م ك م ش ، س م ك أدى إلى تحسن الزيادة الوزنية اليومية حيث تفوقت ($P<0.05$) مجموعة T2 وتبعتها مجموعة T3 ثم جاءت مجموعة المقارنة أخيرة.

أوضحت نتائج الدراسة إلى أن إستخدام محتويات الكرش المجففة شمسيا وسيلاج محتويات الكرش بالإحلال الجزئى محل 50 % من محتوى بروتين العلف المركز المصنع لمجموعة العليقة القاعدية ، لم يؤد إلى ظهور أى آثار صحية سلبية أو مرضية على الحيوان أو على أدائه.

وأظهرت هذه الدراسة أن الطرق التى إستخدمت لمعالجة محتويات الكرش من مخلفات المجازر (وتحويلها إلى بديل علفى جيد واقتصادى) ذات كفاءة وتمكن من خفض تكاليف تغذية المجترات خصوصا مع ظروف الإرتفاع الحاد فى أسعار الذرة ومكونات الأعلاف التقليدية الأخرى ، كما تمكن من تخفيف حمل التلوث البيئى الناتج من عدم التخلص الآمن منها.