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EFFECTS OF SEAWEED SUPPLEMENTATION TO DAIRY FRIESIAN COWS' RATIONS ON:
1- DIGESTION COEFFICIENTS AND RUMEN FERMENTTION

Ead, H. M. E.[1] ; Eman H. M. Maklad[2] and M. M. El-Shinnawy[2]
1- Animal Production Res. Inst., Agric. Res. Center, Dokki, Giza, Egypt.
2- Animal Production Dept., Fac. Agric., Mans. Univ., Egypt

ABSTRACT

The effect of supplemented seaweed meal from *Ascophyllum nodosum* (S) to concentrate feed mixture (CFM) fed together with rice straw (RS) on the digestion and fermentation using three lactating Friesian cows, with mean metabolic body size ($BW^{0.75}$) of 98 kg was studied. All animals were in the 2nd to 4th lactation season.

The experimental rations were formulated as follows:
R1: ration 1: 69.3 % (CFM) + 30.7% (RS), (as a control ration).
R 2: ration 2: 68.3% CFM + 30.7 % (RS) + 1.0% (S).
R 3: ration 3: 67.5 % CFM + 31.0 % (RS) + 1.5% (S).

These proportions were chosen to achieve approximately iso-nitrogenous and iso-caloric rations. The dry matter intake (% of body weight) increased when feeding on R2 (4.55) or R3 (4.5) than feeding on R1 (4.13). The apparent digestibility of all nutrients and feeding values were significantly (P<0.05) higher with R1 than the others, except for nitrogen free extract (NFE) which increased (p<0.05) with R1 and R2 than R3, while unavailable neutral detergent fiber (UNDF) was significantly (P<0.05) higher with R3 than R1 and R2 and there was no significant effect on hemicllulose digestibility.

The mean values of the buffering capacity (BC) increased (P<0.05) with R2 than R1 and R3, while the mean values of the total VFA concentration was significantly (P<0.05) higher with R3 than R1, but without significant difference between R1 and R2 or R2 and R3. The mean values for VFA were 7.47, 10.63 and 13.23 ml eq / 100ml with R1, R2 and R3 respectively. The ruminal NH3-N concentrations ranged from 5.5 to 7.13 mg / 100 ml RL with different rations, but without significant differences.

The predicted values using net carbohydrate and protein system (CNCPS) showed that the passage rate was higher when feeding on R2 (7.96 %/h) or on R3 (7.11 %/h) than feeding on R1 (6.5 %/h). The fiber, sugars and starch fermentations were higher when feeding on R2 (528, 562 and 2309 g/d, respectively) or with R3 (556, 589 and 2325 g/d, respectively) than feeding on R1 (527, 537 and 2181 g/d, respectively). The total microbial protein was 3245, 3400 and 3471 g/d when feeding on R1, R2 and R3, respectively.

The present study showed that, dry matter intake improved and rumen fermentation, but there were negative effects on the nutrients digestibility. Future, studies are needed to identify the reasons for the decreased nutrients digestibility.

Keywords: Lactating cows, Seaweed, Rice straw, Digestion coefficients, Fermentation

INTRODUCTION

At the present growth rate, world population will increase drastically from 6-7 billion to 14 billion within the next 30 to 40 years. This population increase will be most rapid in the less developed countries of the humid lowland tropics, where annual increase in food production remains low (Holmes *et al*, 1983). The small farmers of developing countries have limited resources available for feeding their ruminant livestock. They do not have the luxury of being able to select the basal diet but whatever available at no or low cost. The available resources are essentially low digestible roughages such as straw and other crop residues. The major criterion for improvement in production is to optimize the efficiency of utilization of the available fodder resources and maximize animal productivity. It is imperative, however, to understand the requirements for supplements that will provide nutrients that will optimize the efficiency of utilization of that feed resource (Leng, 1982).

When diets for the dairy cow are formulated, energy, protein and minerals are often the primary factors to be balanced. A negative energy balance appears with many dairy cows during the first few weeks of lactation as milk production increases at a faster rate than feed intake. The mineral content of a ration is important for the dairy cow, so seaweed meal is added (Weller and Jackson, 2006).

Marine plants have evolved unique biochemical processes and structure in adapting to their chemical, physical, and biological environments.

Seaweed is a totally natural multi-mineral supplement. In contrast to conventional mineral supplements, seaweed is unique in being of plant origin containing a wide range of naturally balanced cheated minerals, trace elements, amino acids and vitamins. Seaweed contains all the minerals and trace elements an animal requires for a normal healthy life. Being totally natural and of vegetable origin seaweed is easily digested and is safely fed to animals of all ages (Sykes, 2009). Seaweed contains laminar an oligosaccharide, which acts as elicitor for β-glucanase. β-glucanase is an important immune stimulator in animals. The chemical composition of an ordinary seaweed meal, as from *Ascaphyllum nodosum*, immediately characterizes the material as low-energy content.

Scott (1990) found that, in the prevailing conditions 200 g of seaweed meal as from *Ascophyllum nodosum* (fortified with K , P and Cu) seems to be a more effective additive than 100 g of the standard mineral mixture, from his experiment with identical twin cows. The mineral content of 200 g of this seaweed meal is equivalent to that 100 g of the mineral mixture.

The main objective of this study was to evaluate the effect of supplemented seaweed meal to concentrate feed mixture fed together with rice straw on the digestion, fermentation, milk production and composition, some blood constituents, feed efficiency and economic efficiency with lactating Friesian cows.

MATERIALS AND METHODS

This study was conducted at El-Karada Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture and Department of Animal Production, Fac. of Agric., Mansoura University.

The experimental rations were formulated as follows:

R 1: ration 1: 69.3 % concentrates feed mixture (CFM) + 30.7% rice straw (RS), (as a control ration).

R 2: ration 2: 68.3% CFM + 30.7 % (RS) + 1.0 % seaweed (S).
R 3: ration 3: 67.5 % CFM + 31.0 % (RS) + 1.5% (S).

The experimental rations were formulated to be almost iso-nitrogenous and contained about 13.0 % crude protein as recommended by ∅rskov *et al.* (1972) to ensure maximal rate of fermentation in the rumen. Such value is recommended for dairy cows of medium production level (Ministry of Agriculture, 1996).

The intake of tested ration by cows was restricted and calculated as the percentage of roughage to concentrate ratio to satisfy their maintenance and production requirements (Ghoneim, 1967). The concentrate feed mixture (CFM) used contained 44% yellow corn , 23% soybean meal (44% protein), 14% wheat bran, 11.5% rice bran , 4.5% molasses, 2%, limestone and 1% salt.

The supplemented seaweed meal as from *Ascophyllum nodosum* manufactured by Acadian Sea plants Limited, Canada. Its approximate analysis by Fike *et.al* (2001) showed: crude fiber (6%), carbohydrates (52%), ash (22%), crude protein (6%), calcium (1-3%), phosphorus (.1-.2%), copper,ppm (4-15), iodine,ppm (<1000), magnesium (.5-1.0%), manganese,ppm (10-50), potassium (2-3%), sulpher (2-2.3%), amino acids (g of amino acid/100 g of protein), alanine (5.3), arginine (8), aspartic acid (6.9), glutamic acid (10), glycine (5), lysine (4.9), methionine (.7), threonine (2.8), carotine,ppm (30-60), niacine,ppm (10-30), ascorbic acid,ppm (100-200) and Vit.K,PPM (10).

Experimental animals:

Three digestibility trials were conducted using three lactating Friesian cows, with mean metabolic body size ($BW^{0.75}$) of 98 kg. All animals were in the 2^{nd} to 4^{th} lactation season to determine nutrients digestibility coefficients and nutritive values of the experimental rations. Each digestibility trial was running at the last 5 days as a collection period for each experiment. During the digestion trials, cows were fed their allowances according to the experimental assignment of the group. The CFM fed with or without ground seaweed was offered firstly at the morning. While rice straw was offered after consumption of the CFM. Acid insoluble ash (AIA) was used as a natural marker (Van Keulen and Young, 1977). Nutrients digestibility was calculated from the equations stated by Schneider and Flatt (1975).

Chemical analysis:

Samples of CFM and RS were taken at the beginning of the trials. The composite samples were dried in a forced air oven at 65°C for 48 hours, then ground and running the chemical analysis for each. Fecal samples were grabbed from the rectum of each cow twice daily with 12 hours interval for 5 successive days of each trial and dried in a forced air oven at 65°C for 48 hours. Dried samples were composted for each cow and representative samples were taken, ground and kept for chemical analysis.

Chemical analysis of CFM, RS, S and feces was carried out according to the methods of AOAC (1990), fiber fractions (NDF,ADF ADL, Hemc. and Cell.) were determined according to method of Van Soset (1982).

At the end of each collection period, ruminal fluid samples were taken using rubber stomach tube at 3 hrs post- feeding from three animals in each treatment. The collected rumen fluid samples were filtered through three layers of gauze without squeezing for the determination of pH, buffering capacity (BC), ammonia-N and total volatile fatty acids (TVFA's) concentration. Ruminal pH was estimated by pH meter (Orion Research, model 201 digital pH meter). Buffering capacity was the milli-equivelaents of HCl required to bring the pH of 100 ml rumen liquor to pH 4.5 (Nickolson *et al*, 1963) determined immediately after sampling. Ruminal NH_3-N was determined according to Conway (1957). The TVFA's were determined by the steam distillation method as described by Warner (1964).

The nutritive analysis:

The mechanistive sub models as published by Russell *et al*. (1992) was applied on the experimental rations to predict microbial growth from their carbohydrate and protein fractions and their digestion and passage rate using the net carbohydrate and protein system (CNCPS) programmed version 3.0.

Statistical analysis:.

The statistical analysis was performed using the least squares method described by Likelihood programmed of SAS (1994). The obtained data for nutrients digestibility, nutritive value, effective NDF (eNDF) and rumen parameters, were subjected to one way analysis of variance according to the following model:

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

Where: Y = Observation of the tested factor

μ = Overall mean

T_i = Treatment effect

e_{ij} = Error

The differences among means were carried out according to Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical analysis of concentrate feed mixture (CFM), seaweed (S) and rice straw (RS) which were used in the experimental diets are shown in Table (1). It was clear that, the ingredients analyses were within the normal published ranges (Wiedmeier *et al* 2001 and Maklad *et al* 2005).

Concentration of fiber is negatively related to quality because forages with high fiber content has less available energy and are consumed in lesser amounts by cows than are forages with low amount of fiber (Weiss *et al,* 1982).

Wheeler (2003) recommended the concentrations of non-fiber carbohydrate (NFC) in lactation diets (% of diet DM) should not fall bellow 20 to 25%, or not go above 40 to 45%. The NRC (2001) also recommended the concentrations of NDF and NFC in lactation diets (% of diet DM). Diet should never exceed 44% NFC or contain less than 25% total NDF or less than 15% forage NDF.

1

Table (2) showed the effect of feeding the experimental rations on average daily dry matter intake. The total daily dry matter intake was higher as% BW when feeding on ration 2 or ration 3 (4.55 and 4.5 % BW respectively) than ration 1 (4.13% BW). The average daily intake of CFM ranged from 3.11 to 3.04 when feeding on R2 or R3, respectively and 2.86% BW for R1. The RS was 1.54% BW when feeding on R2 or R3, while it was 1.4 % BW for feeding R1.

The average daily dry matter intake of each experimental diet was in accordance with those of Hagemeister *et al*, (1981).

The individual cow's daily production depends not only on its genetic characteristics and its stage of lactation but mainly on the quantity of nutrients to its intermediary metabolism. This supply is the result of the voluntary intake and the nutrient density of feed intake (Preston and Leng, 1987). The voluntary intake of feed depends essentially on the rate of degradation of its digestible matter into particles of a size small enough to enable their passage from the reticulo-rumen to the lower gut. This degradation is achieved by means of the microbial fermentations which takes place in the reticulo-rumen. The cell wall content and its magnitude and nature of lignifications of these cell walls are amongst the most important factors which govern the digestibility and the rate of passage of a forage (Preston and Leng, 1987).

Table (2): Average daily dry matter intake of concentrate, rice straw and seaweed by dairy cows.

Items	R 1	R2	R 3
Roughage : concentrate	69.3 : 30.7	69.3 : 30.7	69 : 31
Intake of DM from :			
Concentrate feed mixture (CFM) :			
Kg/h/d	12.96	14.14	13.84
As % BW	2.86	3.11	3.04
Rice straw (RS) :			
Kg/h/d	5.74	6.35	6.35
As % BW	1.40	1.54	1.54
Seaweed (Kg/h/d)	0.00	0.20	0.30
Total dry matter intake:			
Kg/h/d	18.70	20.69	20.49
As % BW	4.13	4.55	4.50

Scott (1990) reported that the *Ascohpyllum nodusum* grows readily in the cold coastal waters of Canada's Atlantic coast as well as around Iceland and Scandinavia. It is harvested by hand and air-dried (with some mechanical drying, depending on the time of year). Analysis by British Biochemistry Laboratory shows that kelp meal contain, as well as some 18 amino acids, 60 minerals and trace elements. Kelp meal is rich in nitrogen, carbohydrates and also contains considerable amounts of β carotene (the precursor of vitamin A), as well as vitamins E, D and K and some B vitamins. Among the trace elements found in kelp are magnesium, fluorine, manganese, molybdenum, tellurium, thallium, vanadium, tungsten, zinc and zirconium. Deficiencies of these elements are known to cause a variety of disorders in man and animals.

Scott (1990) also showed that the amino acids include aspartine, glutamine, serine, glycine, valine, plus methionine, leucine and arginine. Biologists believe that the amino acids, when absorbed by cow's rumen, enhance the microbial action within the rumen.

Table (3) shows the effect of feeding the experimental rations on the digestion coefficients and feeding values. The apparent digestibilities and feeding values were significantly (P<0.05) higher with feeding on R1 than the other treatments except for NFE and UNDF. The apparent digestibility for NFE was higher (P<0.05) when feeding on R1 or R2 than R3, while the apparent digestibility for UNDF was higher (P<0.05) when feeding on R3 than the others and there was no significant effect on hemicellulose digestibility when feeding on the experimental rations. In generally, increasing seaweed level in the ration led to decrease nutrients digestibility and feeding value of the diet.

Table (3): Effect of feeding the experimental rations on the digestion coefficients and feeding values by cows.

Items	Ration 1	Ration 2	Ration 3	SEM	*P*
Nutrient digestibility (%):					
DM	62.59[a]	51.06[b]	44.42[c]	1.8129	0.0149
OM	66.88[a]	60.89[b]	58.07[b]	1.4009	0.0685
CP	61.89[a]	50.40[b]	43.85[c]	1.8458	0.0162
EE	74.72[a]	42.79[b]	32.84[c]	2.5311	0.0019
CF	49.46[a]	39.13[c]	44.48[b]	1.3345	0.0356
NFE	69.97[a]	65.97[a]	60.34[b]	1.3524	0.0453
NDF	57.66[a]	49.19[b]	47.52[b]	1.4202	0.0380
ADF	48.66[a]	33.63[b]	36.44[b]	1.2215	0.0057
Hemi.	68.33	67.71	60.75	2.3886	0.3099
Cell.	67.79[a]	48.23[b]	53.97[b]	1.9023	0.0121
ADL	14.24[a]	7.15[b]	4.49[b]	0.4976	0.0009
NFC	87.14[a]	90.39[a]	83.08[b]	1.3715	0.1144
UNDF	2.95[b]	3.62[b]	9.74[a]	1.0056	0.0415
ANDF	76.74[a]	65.03[b]	60.64[b]	2.1208	0.0351
NDS	68.76[a]	53.39[b]	40.51[c]	2.4043	0.0085
RAC	73.71[a]	59.72[b]	50.37[c]	2.2750	0.0139
Feeding value (%)					
TDN	60.41[a]	53.55[b]	49.83[c]	1.062	0.0148
DCP	8.12[a]	6.56[b]	5.68[c]	0.2409	0.0141
TDN:CP (ratio)	4.60[a]	4.11[c]	3.85[c]	0.0794	0.0178
ME(Mcal/kg)	2.15[a]	1.91[b]	1.77[c]	0.0376	0.0151
ME(Mj/Kg)	8.99[a]	7.97[b]	7.42[c]	0.1576	0.0148
NE(Mcal/Kg)*	1.36[a]	1.19[b]	1.10[c]	0.0256	0.0140
DDM%**	55.74[a]	45.47[b]	39.56[c]	1.6150	0.0149
RFV***	179.25	160.19	138.11	13.2204	0.2036
RFQ****	203.73	198.11	182.30	12.7608	0.2178
QI*****	2.64	2.57	2.38	0.1604	0.2224

a, b and c : Means within the same raw with different superscripts are significantly different (P<0.05).

*** NE (Mcal / kg) = (TDN% x 0.0245) – 0.12 (NRC, 2001)**

**** DDM% of DM = 88.9 - 0.779 x (ADF% of DM) (Schroeder , 1996)**

***** RFV = DMI x DDM / 1.29 (Schroeder , 1996)**

******RFQ = (DMI% of BW) * (TDN% of DM) / 1.23 (Moore, 1994)**

*******QI = 0.0125*RFQ + 0.097 (Moore, 1994)**

Behrends *et al*.(2000) reported an antibacterial activity from extract of *Ascophyllum nodosum.* Antibacterial activity was found against 10 to 11 organisms tested *in vitro*. Activity against both Gram-positive and Gram-negative types was observed. Dubeski (1999) suggested that a small excess intake of certain nutrients including β –carotene, vitamin E, Zn, and Se seems to enhance immune response, but when they are supplied above certain threshold immunity can be depressed.

Hall (2001) reported that construction of a ration, it must has potentially higher digestible fiber and non-fiber carbohydrate contribution to the ration. These conditions allow for construction of a ration that has a greater opportunity to promote optimum animal performance.

The results in Table (4) show that there were no significant effects on the mean values of ruminal pH when animals were feeding on R1, R2 and R3. The mean values were 6.53, 6.37 and 6.27 respectively.

The mean values of the buffering capacity (BC) as shown in Table (4) was higher ($P<0.05$) when feeding on R2 than feeding on R1 or R3, while the VFA concentration was increased ($P<0.05$) with feeding on seaweed rations. The VFA was higher ($P<0.05$) with feeding on R3 than R1, but there was no significant effect when feeding on R2 and R1 or R3.

As shown in Table 4, the riminal NH_3-N concentration, were ranged from 5.5 to 7.13 mg/100 ml rumen liquor with different treatments, but without significant effect.

The present results are inagreement with those of Leng and Nolan (1984), who reported that in deferent production systems, ruminants consume many type of carbohydrates, proteins and other plants. All digestible carbohydrates are fermented to volatile fatty acids (VFA) plus methane and carbon dioxide by microbial action. Protein is degraded by microbial enzymes in the rumen to give the same three end products plus NH_3. In all cases, a proportion of the substrate metabolized by microbes is used for synthesis of the microbes. The microbial fermentation of soluble protein in the rumen is an unavailable consequence of ruminant mode of digestion.

Durand and Kawashima (1980) reported that both the macro-and microelements affect the processes that proceed in the animal's organism in the different ways, and through their presence in the digestive tract, they also influence the fermentation processes in here. An impact of the main mineral ingredients or the rumen contents fermentation had been found consisting in the regulation of its physiochemical properties such as osmotic pressure, buffering ability or oxide-reduction potential. Besides, some chemical elements may directly influence the course of the bacterial processes. Thus for example, cellulose degradation in suspension of rumen bacteria cell is accelerated by the following elements: P, Mg, Ca, K, Na, Fe, Zn, Mn, Co, Mo, whereas the volatile fatty acid synthesis in the rumen fluid may be increased by Mn, Co and Zn.

On the other hand, ammonia, peptides, amino acids and amines from the nitrogenous substrate for the synthesis of microbial cells but NH_3 is the most important source of N for the microbes that ferment forages. Ammonia is used by many species of rumen microorganisms as their source of N for protein synthesis (Leng and Nolan, 1984). A deficiency of rumen NH_3 results in a low microbial growth rate which may reduce digestibility of fiber.

Estimates of the critical level of NH_3 in the rumen fluid for efficient digestion has been reported to be low as 50 mg N/l or as high as 200 mg N/l. However, recent studies have shown that, when NH_3 concentration fall bellow about 200 mg N/l, the rumen microorganisms are inefficient and are likely to respond to dietary NPN supplements (Perdok and Leng, 1989).

Intake of straw by cattle has been shown to increase by increasing urea levels in the diet until the level of NH_3 reaches 200 mg N/l (Perdok and Leng, 1989). It is now necessary to assess the requirements for N by ruminants in terms of the amount of NH_3 and AA needed by the rumen microbes, and the amount of digestible by-pass protein needed by the animal to augment the total protein (amino acids) available to the animal and to create an efficient metabolism.

Fouad (2002) reported that the effective NDF (eNDF) was calculated to estimate adjustments in ruminal pH useful only when eNDF was below 30%. Fiber digestion is at normal levels when eNDF is at least 20%. In addition to prediction of ruminal pH and eNDF were used to adjust passage rate.

Herrera-Saldana *et al* (1990) showed that cows in early lactation, fed a synchronous diet for fast rumen degradation of energy and N, produced more milk than those fed slowly fermentable synchronized diets or asynchronous diets, probably due to higher production of microbial protein.

Shabi *et al* (1999) reported that, an increased frequency of feeding can promote substantial diurnal fluctuations in rumen concentrations of NH_3, VFA and lactic acid. These extreme conditions of metabolites can inhibit microbial growth and activity and consequently, microbial degradation of feed.

There appear to be on interaction between energy level and frequency of feeding in relation to the apparent and true efficiency of bacteria N synthesis, suggesting that the efficiency of bacteria N synthesis can be improved when diets with moderate or high levels of concentrate feed are offered more frequently (Cecava *et al.,* 1990).

Therefore, synchronizing energy and N available to enhance the output of microbial protein from the rumen and efficiency of ruminal fermentation, there by improving feed utilization and animal performance (Cabrita *et al.*, 2006).

Table (4): Effect of feeding experimental rations on some rumen liquor parameters at 3 hr after feeding.

Parameters	R 1	R 2	R 3	SEM	*P*
PH-Values	6.53	6.37	6.27	0.1071	0.5800
Buffering capacity BC (ml eq/100ml)	10.10^{b}	15.20^{a}	10.48^{b}	0.9726	0.0882
Total VFA's (ml eq/100ml)	7.47^{b}	10.63^{ab}	13.23^{a}	1.1644	0.1256
NH_3-N (mg/100ml)	5.93	7.13	5.50	0.6366	0.5047
%eNDF*	26.21	22.27	19.90	2.5334	0.5798

a, b: Means within the same raw with different superscripts are significantly different (P<0.05).

*** % eNDF = (pH - 5.425) / 0.04229 (Fox *et al.*, 2000)**

On the other hand Kellems and Church (1998) reported that dietary nutrients' densities are minimized when feed consumption is maximized, making it easier to formulate rations that are adequate in nutrients. The amount of feed that a dairy cow consumes is highly correlated to its nutrient intake. Every effort should be made to maximize feed consumption when feeding dairy cattle . They also showed that the most cost-effective feeding programmes can be implemented when feed consumption is maximized. Maximized feed consumption minimizes the cost of providing required nutrients because higher level of forages and by-product feeds can be incorporated into the ration. The quality of forage has a dramatic effect on feed consumption. Feeding the highest quality forage will maximize feed consumption and nutrient intake and minimize dietary nutrients densities, ration cost and the quantities of concentrates that used to be incorporated into a ration.

Table (5): The metabolizable protein (MP), microbial growth and passage rate of tested rations.

Item	R1	R2	R3
MP from bacteria (g/d)	1217	1275	1302
MP from UIP (g/d)	813	967	906
Fiber fermentation (g/d)	527	538	556
Sugar fermentation (g/d)	537	562	589
Starch fermentation (g/d)	2181	2309	2325
Total microbial protein (g/d)	3245	3400	3471
Total passage rate (%/h)	6.5	7.96	7.11

In general as shown in Table (5) the predicted values using CNCPS showed that, the DM intake was increased when feeding on R2 or R3 than R1 because the passage rate was higher when feeding on R2 (7.96 %/h) or on R3 (7.11 %/h) than feeding on R1 (6.5 %/h). The total VFA was also increased with feeding on R2 or R3 than feeding on R1 because fiber, sugar and starch fermentations were higher when feeding on R2 (528, 562 and 2309 g/d, respectively) or with R3 (556, 589 and 2325 g/d, respectively) than feeding on R1 (527, 537 and 2181 g/d respectively). And the total microbial protein was 3245, 3400 and 3471 g/d when feeding on R1, R2 or R3, respectively.

The presented study, may lead to concluded that the supplemented 1.5% seaweed of the total dry matter intake when feeding on the concentrate feed mixture as a basal diet in lactating cow rations may enhance the immune response, but more information is needed on its mode of action and method of administration. Although some responses of the negative effects on the digestion were observed. On the other hand, to maximize feed consumption, seaweed supplement may be necessary for lactating cow feed the highest quality roughages as a basal diet, and this needs further studies.

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1- معاملات الهضم وتخمرات الكرش.

حسين محمد الشافعى عيد[1], ايمان حنفى محمود مقلد[2] و محمد محمد الشناوى.[2]
1- معهد بحوث الانتاج الحيوانى - مركز البحوث الزراعية - مصر
2- قسم انتاج الحيوان - كلية الزراعة - جامعة المنصورة – مصر

أجرى هذا البحث بهدف دراسة تأثير إضافة نسبتين من الطحالب البحرية *Ascophyllum nodosum* (1,0 و 1,5 %) من المادة الجافة المأكولة الكلية على كل من معاملات الهضم والقيمة الغذائية وبعض المعايير لسائل الكرش.

وتم تكوين ثلاث علائق على النحو التالى:

(عليقة أولى) : 69, 3 % مخلوط علف مصنع + 30, 7 % قش أرز
(عليقة ثانية) : 68, 3 % مخلوط علف مصنع + 30, 7 % قش أرز + 1, 0 % طحالب بحرية
(عليقة ثالثة) : 67,5 % مخلوط علف مصنع + 31, 0 % قش أرز + 1, 5 % طحالب بحرية

وكانت الخلطات الثلاثة متماثلة فى نسبة البروتين حيث تراوحت بين (12,94 – 13,13 %) ومستخلص الألياف المتعادل (55, 58 – 55, 67 %).

أستخدمت ثلاثة أبقار حلابة بمتوسط وزن 457 كجم وكانت بين الموسم الثانى الى الرابع وتم أخذ عينات الروث لإجراء التحاليل المطلوبة لتجارب الهضم وأخذ عينات سائل الكرش بواسطة اللى المعدى بعد 3 ساعات من الأكل لتقدير تركيز أيون الهيدروجين , والسعة التنظيمية للكرش , تركيز الاحماض الدهنية الطيارة ,تركيز الامونيا

\وكانت أهم النتائج المتحصل عليها كما يلى :

1- زادت كمية المأكول من المادة الجافة (55, 4 و 50, 4 % من وزن الجسم) بالتغذية على العليقة الثانية والثالثة على الترتيب مقارنة بالعليقة الأولى (13, 4 %) وكان سرعة مرور الكتلة الغذائية للعليقة الثانية والثالثة هى (7,96 و 11, 7 % / ساعة على الترتيب) بينما كانت 5, 6 % / ساعة للعليقة الأولى.
2- كانت معاملات هضم المركبات الغذائية مرتفعة معنويا (05, 0) بصفة عامة عند التغذية على العليقة الاولى فيما عدا المستخلص خالى الأزوت حيث كان مرتفعا معنويا (05, 0) عند التغذية على العليقة الاولى والثانية مقارنة بالعليقة الثالثة . ولم يكن هناك تأثير معنوى على معاملات هضم الهيميسليولوز للعلائق المختبرة.
3- زادت قيمة السعة التنظيمية لسائل الكرش معنويا (05, 0) بالتغذية على العليقة الثانية مقارنة بالعليقة الاولى والثالثة بينما زاد تركيز الأحماض الدهنية الطيارة معنويا (0,05) بالتغذية على العليقة الثالثة مقارنة بالتغذية على العليقة الأولى ولكن لم يكن هناك تأثير معنوى بين العليقة الثانية والأولى أو الثانية والثالثة . وكانت القيم المتحصل عليها هى 47, 7 و 63, 10 و 23, 13 مللى مكافىء / 100 مللى سائل كرش لكل من العليقة الاولى والثانية والثالثة على التوالى.
4- تراوح تركيز الأمونيا بين 5, 5 – 13, 7 مللجم / 100 مل سائل كرش عند التغذية على العلائق المختبرة ولكن لم تظهر فروق معنوية.

وقد أشارت نتائج التحليل الغذائى الى زيادة كمية البروتين الميكروبى المتكون عند التغذية على العليقة الثانية أو الثالثة (3400 و 3471 حم / يوم) مقارنة بالتغذية على العليقة الأولى 3245 حم / يوم.

مما سبق يتضح أن هناك تحسن ملحوظ فى كمية المأكول وتخمرات سائل الكرش نتيجة لإضافة الطحالب البحرية ولكن قد يكون هذا من المفيد عند التغذية على مواد علف خشنه جيدة كعليقة اساسية عند تغذية الحيوانات الحلابة مما يلزم بعض الدراسات مستقبلا.

قام بتحكيم البحث

أ.د / عبد الحميد محمد عبد الحميد	**كلية الزراعة – جامعة المنصورة**
أ.د / حسين سعد سليمان	**كلية الزراعة – جامعة عين شمس**

Table (1): The chemical composition of the ingredients and experimental rations.

Item	DM	Chemical composition (% as DM)															
		OM	CP	EE	CF	NFE	Ash	NDF	ADF	Hemi.	Cellu.	ADL	NFC*	UNDF[1]	ANDF[2]	NDS[3]	RAC[4]
Ingredients																	
Concentrate feed mixture (CFM)	88.36	94.84	16.77	2.24	10.90	64.93	5.16	42.00	18.47	23.53	10.35	8.12	33.83	8.19	33.82	58.00	80.94
Seaweed (S)	88.00	75.00	6.80	2.30	6.80	59.10	25.00	36.52	20.06	16.46	15.72	4.34	29.38	3.80	32.72	63.48	86.23
Rice straw (RS)	90.63	80.47	4.88	0.22	29.31	46.06	19.53	73.75	56.63	17.12	39.85	16.78	1.62	29.70	44.05	26.25	61.83
Experimental rations																	
69.3% CFM+30.7% RS	100	90.44	13.13	1.62	16.54	59.15	9.56	55.60	30.16	25.44	19.38	10.77	20.09	14.37	41.22	44.40	74.83
68.3% CFM + 30.7% RS+ 1.0% S	100	90.23	13.02	1.62	16.51	59.08	9.77	55.58	30.21	25.37	19.46	10.74	20.02	14.33	41.25	44.42	74.89
67.5% CFM + 31% RS+ 1.5% S	100	90.10	12.94	1.61	16.54	59.01	9.90	55.67	30.32	25.36	19.57	10.75	19.87	14.36	41.31	44.33	74.87

*** Non fiberous carbohydrates%= OM% - (CP%+NDF%+EE%), (Calsamiglia *et al.,* 1995).**
(1) UNDF : Unavailable NDF = NDF x 0.01 x ADL x 2.4 (Fox *et al*., 2000) .
(2) ANDF : Available NDF = NDF – UNDF
(3) NDS : Neutral detergent soluble = 100 – NDF
(4) RAC: Rumen available carbohydrate =

$$\frac{[\ 0.9\ (\ NDS - (\ Protein\ +\ Lipid\ )\ +\ (\ NDF\ \times\ NDF\ availability\ )\ )\ ]}{[\ (\ NDS - (Protein + Lipid\ ))\ +\ NDF\ ]}$$

(**Nocek and Russell, 1988**)