INFLUENCE OF FEEDING DIFFERENT LEVELS OF SOYBEAN MEAL IN GROWING FRIESIAN CALVES RATIONS ON:
1- DIGESTIBILITY, SOME RUMEN PARAMETERS, BLOOD CONSTITUENTS AND GROWTH PERFORMANCE.

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ABSTRACT

Fifteen male Friesian calves with average body weights of 150 ± 14 kg and 8 ± 0.94 month of age were used in this study. Calves were randomly distributed into three similar groups (five for each). The experimental rations were formulated as follows: ration 1 (R1): 63 % concentrate feed mixture (CFM) + 37 % clover hay (CH) (control), ration 2 (R2): 52.5 % CFM +7.5% soybean meal (SBM)+40% CH and ration 3 (R3): 47 % CFM +11% SBM+42% CH.

The partial replacement of CFM by SBM increased the CP% of rations 2 and 3. The CP concentration of the tested rations was 13.6, 15.6 and 16.6% for R1, R2 and R3, respectively. Nutrients digestibility tended to be higher (p<0.05) when SBM was supplemented at 11% than 7.5%. The TDN%, The ME (M cal/kg) and NE (Mcal/kg) and g CPI / ME Mcal were higher (p<0.05) with feeding on R2 or R3 than R1, while the TDN: CP ratio was higher (p<0.05) for R1 than R2 or R3. likewise, the digested dry matter (DDM%) was higher (p<0.05) by feeding calves on R2 or R3 than R1. The relative feeding values (RFV), relative feeding quality (RFQ) and quality index (QI) were higher (p<0.05) when the rations supplemented with SBM.

The total concentration of ruminal VFA was higher (p<0.05) for calves in R2 or R3 than R1. Blood urea-N and glucose concentration were higher (p<0.05) for calves in R3 than those in R1 and R2.

The average daily gain kg/day and feed efficiency were higher (p<0.05) when animals were fed R2 or R3 than R1.

It could be concluded that the replacement CFM by SBM at a level 11% level of total DMI would improve nutrients digestibility, average daily gain and feed conversion of the growing calves.

Keywords: Friesian calves, clover hay, soybean meal, daily gain, live body weight and non fibrous carbohydrates (NFC).

INTRODUCTION

Animal nutrition is an integral part of animal production. It has changed drastically as a consequence of development in many other disciplines of animal science and also because of changes in animal husbandry practices.

Developments in disciplines have been so much related that one discipline could not have developed in isolation without development in the other. For instance, animals have been bred to have an increased production, but the expression of this enhanced genetic potential was only possible by continuous adjustment of nutrition to the genotype of the animal.

On the other hand, differences in animals have led to research on different nutritional needs of these animals (Verstegen and Tamminga, 2001).

Animal nutrition will depend on the availability of feedstuffs to provide feed to them in addition to the need of the growing human population. It is expected that demand for meat and other animal products will sharply increase as a result of an increasing human population (Pinstrup-Anderson *et al* 1997).

Ruminant production in many countries is often on the basis of crop residues high in fiber, of low digestibility and poor in many essential nutrients. Future challenges are to find ways to improve digestibility and to find suitable supplements to eliminate their deficiencies. The use of legume trees and shrubs receives much attention these days. They can provide essential nutrients, but also contain many anti-nutritional factors which have to be eliminated (Tamminga *et al* 1999).

Progress in productively in such animal production systems will probably remain slow and the first priority is to feed the rumen microbes rather than the animals knowledge functioning of these animals and their physiology will enable to develop proper feeding practices. In combination with the study on animals which produce, for example, more protein in their body compared to lipid it is important to study which components in the natural diet have effects on partitioning of protein and lipids.

It is now known that for early growth, ruminants require more protein relative to energy than is provided by even the most efficient rumen. Ruminants given poor quality forage generally respond to supplements that contain significant amounts of protein that escapes to the intestines to be absorbed as amino acids (Ieng, 1990).

In current AFRC (1993) and NRC (1996) feeding systems, CP recommendations (on DM basis) for calves under 250 kg BW exceed 16%. The CP concentrations of 17 to 18% are broadly recommended for rabidly growing animals (Kertz *et al*, 1987). However, using factorial approach, lower CP concentrations may be recommended, assuming AFRC (1993) or NRC (1996) efficiency of microbial protein synthesis.

The objectives of this study were to evaluate the effects of different protein concentration in growing Friesian calves rations on nutrients digestibility, ruminal fermentation and performance.

MATERIALS AND METHODS

The experimental work of 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 during the year 2003 to 2004.

Experimental animals:

Fifteen male Friesian calves with an average body weight of 150 ± 14 kg and 8 ± 0.94 month of age were used. Calves were randomly distributed into three similar groups (five for each group) according to their

live body weight and age. According to Ritchie (1994) recommendation, the phases of beef production could be divided as follows:

1-Cow-calves phase: wean 225 kg at 7 to 8 month of age.

2-Stocker (backgrounding) phase: grow calf for 4 to 6 month.

3-Finishing or feedlot phase: market after 3 to 6 month.

4-Total time, birth to market 14 to 20 month.

The experimental work of present study will consisted of these stages and will be presented in two separate sequence papers as follows:

In the present study the first period will be involved, the first 150 days of the experiment (stocker phase), the second period, including the following 90 days after stocker phase (finishing phase) will be presented in the 2nd part of this study (Ead, 2006).

Experimental rations :

Calves were assigned randomly for three experimental groups to be fed on:

Ration 1: R1: 63% concentrate feed mixture (CFM)+37% Clover hay (CH)(control).

Ration 2: R2: 52.5% CFM + 7.5% soybean meal (SBM) + 40% CH.

Ration 3: R3: 47% CFM + 11% SBM + 42% CH.

The SBM was used to replace CFM in tested rations to elevate the CP level in R2 and R3.

The CP concentration was 13.6, 15.6 and 16.6% for R1, R2 and R3, respectively based on NRC (1996) recommendations for feeding calves during this period. The allowances was adjusted monthly according to their body weight changes. Calves were individually fed the experimental rations. Animals were fed to cover the requirements of growing calves.

The CFM used contained wheat bran, undecorticated cotton seed meal, yellow corn, molasses, limestone, and salt. The clover hay was made from the 3rd cut of Egyptian clover.

Management of feeding

The CFM was fed with or without SBM and was offered to calves at morning , while clover hay (CH) was given after consumption of the concentrates. Minerals-vitamins blocks were available for animals free choice. Drinking fresh and clean water was available at all times.

Weighing procedure:

Animals were weighed in the morning before drinking and feeding at the beginning of the trial and monthly thereafter to the nearest kg for each animal.

Digestion trials:

Three digestibility trials were conducted using three animals chosen randomly from each group to determine nutrients digestibility coefficients and nutritive values of the experimental rations. The digestibility trials were conducted at the fourth month from the beginning of the experiment. Animals were fed their allowances according to the experimental assignment of each group. 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).

Feces samples were taken from the rectum of each calves twice daily with 12 hours interval during the collection period of each trial and dried in a forced air oven at 65°C for 48 hours. Dried samples were composted for each animal and representative samples were taken, ground and kept for chemical analysis.

Samples of CFM, CH and SBM were taken at the beginning, middle and at the end of each trial. At the end of the collection period composite samples were dried in a forced air oven at 65°C for 48 hours, then ground and kept for chemical analysis.

Chemical analysis, rumen fermentation and blood parameters:

Proximate chemical analysis of CFM, CH, SBM and feces were carried out according to the methods of AOAC (1990). Fiber fractions (NDF,ADF and ADL), while hem. and cell. were calculated by deference (NDF- ADF)% and (ADF- ADL%), respectively according to method of Van Soset, (1982). Acid insoluble ash was determined according to method of Van Keulen and Young (1977).

Ruminal fluid samples were taken using rubber stomach tube before offering the morning feed and at 2, 4 and 8 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, ammonia-N and total volatile fatty acids (TVFAs) concentration. Ruminal pH was estimated by pH meter (Orion Research, model 201 digital pH meter). Ruminal NH_3-N was determined according to Conway (1957). The TVFAs were determined by the steam distillation method as described by Warner (1964).

Blood samples were taken from the jugular vein of calves at 3 hrs post-morning feeding. Blood samples were separated by centrifugation at 4000 r.p.m for 10 minutes. The serum samples were frozen at −20°C until analysis for total proteins, (Doumas *et al.*, 1981); albumin, (Hill and Wells, 1983); globulin, (calculated by differences between the total protein and albumin concentrations); urea, (Freidman *et al.*, 1980); creatinine, (Ullmann, 1976); Glucose, (Teuscher and Richterich, 1971) and GOT and GPT, (Reitman and Frankel, 1957).

Production efficiency :

The ME can be converted to an NEm requirement with an efficiency of 0.576 (NRC, 1996), and NEp will be equal (ME − NEm)..

The retained energy (RE, Mcal/d) = (live weight $^{0.2955}$ * 0.544) * $(ADG)^{1.262}$

Where ADG is in kilograms (Overton, 1999).

Production efficiency = RE/NE_p * 100

Economic evaluation.

Economic efficiency was calculated according to the following formula:

Economic efficiency = $\dfrac{\text{(price of daily gain − daily feed cost)}}{\text{daily feed cost}}$

Statistical analysis:.

The statistical analysis was performed using the least squares method described by Likelihood programme of SAS (1994). The obtained data for nutrient digestibility, nutritive value, blood parameters, average monthly body

weight and average monthly daily gain, 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 data of rumen liquor parameters were subjected to two way analysis of variance according to the following model:

$Y_{ijk} = \mu + T_i + P_j + TP_{ij} + e_{ijk}$

Where: Y = Observation of the tested factor

μ = Overall mean

T_i = Treatment effect

P_j = Time effect

TP_{ij} = Interaction effect of the treatment x time

e_{ijk} = Error

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

RESULTS AND DISCUSSION

Chemical analysis:

The summative analysis of the ingredients (Table 1) used to formulate the experimental rations was within the normal published ranges (Cheva-Isarakul and Cheva-Isarakul,1984, Ead, 1999, Maklad and Mohmed, 2000 and Maklad *et al*, 2005).

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	ADL	Hhem	Cellu	NFC*
Ilngredients													
CFM	88.43	93.70	14.37	3.17	6.76	69.40	6.3	36.91	16.90	2.25	20.01	14.65	39.24
SBM	88.99	94.15	43.15	1.65	5.24	44.11	5.85	25.10	6.02	1.78	19.08	4.24	24.26
CH	85.35	88.86	12.34	1.17	20.07	55.28	11.14	49.18	35.24	9.27	13.94	25.97	26.17
Experimental rations													
R1	87.28	91.90	13.62	2.43	11.70	64.15	8.10	41.47	23.71	4.86	17.76	18.85	34.39
R2	87.23	91.80	15.69	2.26	11.97	61.88	8.20	40.94	23.43	5.03	17.51	18.41	32.90
R3	87.19	91.71	16.67	2.16	12.19	60.69	8.29	40.78	23.42	5.16	17.35	18.27	32.10

*Non fiberous carbohydrates%= OM% - (CP%+NDF%+EE%), (Calsamiglia *et al.*, 1995).

The CFM and SBM were lower in NDF, ADF and ADL content and higher in non-fiber carbohydrates (NFC) than CH.

The SBM was higher in CP content (43.15%) than CFM and CH (14.37 and 12.34%, respectively). Protein and energy content vary in soybean meal depending on protein level of the beans, residual fat after processing and whether or not hulls have been removed. The protein content of dehulled material with hulls ranges from 40% to 50% with 44% considered the normal (Swick, 1995). Soybean meal is an excellent source of lysine,

tryptophan and threonine but is deficient in methionine. Digestibility of most amino acids is over 90% in properly processed soybean meal. Variation in total amino acids content of SBM is lower than that observed in fish meal, canola and rapeseed and most likely other protein meals (Swick, 1995). Also, soybean meal is an excellent ingredient that can be used as the sole protein supplement for virtually any class of animal with no restrictions (20 to 25% maximum).

The chemical nutrients of tested rations was found to be practically similar, except that of CP content. The CP concentrations of the experimental rations were increased from 13.62% (control diet) to 15.6% (R2) and 16.6% (R3) by substituting CFM by SBM.

Dry matter intake of tested rations:

Data in Table (2) showed the average daily dry matter intake (ADDMI) from each experimental ration. The concentrate: roughage ratio was abut 60: 40. Feeding high concentrate diet decrease ruminal pH, which may affect efficiency of microbial protein synthesis (Strobel and Russell, 1986). In addition, microbial protein is unable to meet metabolizable AA requirement of growing calves.

Table (2): Average daily dry matter intake of concentrate, clover hay and soybean meal

Items	Ration 1	Ration 2	Ration 3
Average body weight (kg)	255	274	294
Concentrate : Roughage	62 : 38	58 : 42	57 : 43
Intake of DM from :			
Concentrate feed mixture (CFM) :			
Kg/h/d	4.57	4.13	3.83
As % BW	1.80	1.50	1.30
Soybean meal (SBM) :			
Kg/h/d	0	0.44	0.89
As % BW	0	0.21	0.34
Total concentrate :			
Kg/h/d	4.57	4.57	4.72
As % BW	1.80	1.71	1.64
Clover hay (CH) :			
Kg/h/d	2.70	3.13	3.41
As % BW	1.06	1.15	1.16
Total dry matter intake:			
Kg/h/d	7.27	7.70	8.13
As % BW	2.86	2.86	2.80

The ADMI of CFM or CFM+SBM as % of body weight ranged from 1.64 to 1.80%, while the roughage ranged from 1.06 to 1.16% of BW, so the total DM intake ranged from 2.80 to 2.86% of BW. Ritchie, (1994) reported that, if maximum gain is to be achieved, we need to maximize energy intake, which is related to DM intake. Extreme range of DM intake is 1.5 to 3.0% of BW. An animal that is gaining weight at a moderate rate need abut 1.5% of

their body weight in concentrates per day. Soybean meal is the most commonly used protein supplement.

Mathis (2000) reported that, if supplying ruminally degradable protein does not improve production, then supplying escape protein may help. This is especially true for beef cattle with high protein requirements due to growth.

Often, forages contain 12 to 20% CP that is higher degradable in the rumen (ruminally degradable protein > 70% of CP). The high degradability of the forage protein may result in a relatively large portion of the N being absorbed across the rumen wall without being converted to microbial protein. This absorbed N cannot be used completely by the animal. Therefore, it may be necessary to provide a supplement that is high in escape protein (50%) to meat the animals protein requirements. Protein concentrates of plant origin, such as soybean meal, genrally contain 55 to 70% ruminally degradable protein and 30 to 45% escape protein (Mathis, 2000).

Nutrient digestabilities and feeding values of tested rations:

The TDN and DCP% were higher (p<0.05) for R2 or R3 than R1. Heldt, (1998) showed that, if the objective is to optimize intake and digestion of low-quality forages, it is easy to see that supplements should contain more than 30% CP. The TDN% and CP/ME Mcal were higher (p<0.05) with feeding on R2 or R3 than R1, while the TDN/CP ratio was higher (p<0.05) when feeding on R1 than feeding on R2 and R3. metabolizable energy and NE were higher for rations supplemented with SBM.

The dietary ratio of TDN to CP (TDN: CP) is often used to evaluate the energy and protein balance of forage diets. A ratio of about 4: 1 is assumed to maximize forage intake. Most research suggest that protein supplementation may be needed when the TDN: CP ratio is greater than 6: 1 to 8: 1 (Bohnert and Delcurto, 2003).

Table (3): Nutrients digestibility and feeding values of the experimental rations

Items	Ration 1	Ration 2	Ration 3	$\pm$ SE
DMI kg/d	7.27	7.85	8.13	0.38
CPI kg/day	00.99[b]	1.24[a]	1.35[a]	0.07
Nutrient digestibility (%):				
DM	58.62[c]	64.79[b]	68.06[a]	0.48
OM	62.18[c]	67.59[b]	70.93[a]	0.35
CP	57.41[c]	63.72[b]	67.04[a]	0.52
EE	72.97	79.37	76.89	2.54
CF	39.73[b]	45.58[b]	58.73[a]	3.30
NFE	68.47[b]	72.71[a]	74.17[a]	1.15
NDF	53.18[c]	60.47[b]	65.39[a]	0.59
ADF	38.48[b]	42.14[b]	49.54[a]	1.26
ADL	9.19[c]	15.79[b]	30.99[a]	1.36
Hemi.	72.80[c]	84.98[b]	86.76[a]	0.47
Cell.	46.06[b]	49.37[ab]	54.78[a]	1.63
NFC	77.13	78.06	79.47	1.43

Feeding value :				
TDN%	60.38[c]	64.48[b]	67.11[a]	0.43
DCP%	7.82[c]	10.00[b]	11.18[a]	0.22
TDNI kg/day	4.39[b]	5.06[ab]	5.46[a]	0.27
DCPI kg/day	0.568[b]	0.788[a]	0.909[a]	0.05
ME(Mcal/kg)	2.15[c]	2.29[b]	2.39[a]	0.02
ME(Mj/Kg)	8.99[c]	9.60[b]	9.99[a]	0.06
NE(Mcal/Kg)	1.36[c]	1.46[b]	1.52[a]	0.01
DDM%	51.16[c]	56.52[b]	59.35[a]	0.41
RFV	113.25[b]	125.51[a]	127.25[a]	1.59
RFQ****	140.1[b]	150.1[a]	150.9[a]	1.88
QI*****	1.85[b]	1.97[a]	1.98[a]	0.02
TDN / CP	4.43[a]	4.11[b]	4.03[b]	0.06
MEI Mcal/day	15.63[b]	18.02[ab]	19.44[a]	0.94
CP g / ME Mcal	63.37[b]	68.35[a]	69.79[a]	0.05

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 (Digested dry matter) = 88.9 - 0.779 x (ADF% of DM) (Schroeder , 1996)
*** RFV(Relative feeding value) = DMI x DDM / 1.29 (Schroeder , 1996)
****RFQ(Relative feeding quality) = (DMI% of BW) * (TDN% of DM) / 1.23 (Moore, 1994)
*****QI (Quality index) = 0.0125*RFQ + 0.097 (Moore, 1994)

Improving utilization of nutrients in the rumen and better performance were obtained from synchronous utilization of ruminally degradable carbohydrates and protein (Herrera-Saldana *et al* 1990). They reported that to increase microbial N to the small intestine 69.8 g CP to ME ratio (CP: ME; g of CP per Mcal of ME) showed be fed to animals. Casper *et al* (1994) emphasized the synchronization of ruminally degradable carbohydrates and protein (ratio of non-structural carbohydrates to rumen degradable protein((NSC: RDP) is critical for young growing heifers because of limitations in DMI and fermentation capacity. It was hypothesized that locating the correct synchronization of NSC:RDP may increase amino acids flow to the small intestine through increased microbial protein synthesis and efficiency of fermentation, thus maximizing the efficiency of protein toward growth.

The digested dry matter (DDM%) was higher (p<0.05) when feeding on R2 or R3 than R1, so the RFV, RFQ and QI were higher (p<0.05) when the rations were supplemented with SBM than the control.

The QI measures the voluntary intake of TDN above maintenance. When forages are fed without supplemental energy or protein, QI is related to the gain of growing cattle (Moore and Kunkle, 1995). When QI equaled 1.0 the intake of TDN just meets the maintenance requirement, and when QI equaled1.8 average daily gain (ADG) is 0.60 kg for steers.

Moore and Kunkle, 1995) reported that supplements generally (but not always) improved animal performance. The effects on intake and TDN depend on the quality and composition of the forage as will as the composition and amount of the supplement, so the present study showed that there were positive associative effect on the TDN values when the

rations supplemented with SBM (QI results were 1.97 and 1.98 for R2 and R3 and 1.85 for R1).

Rumen liquor parameters:

Ruminal pH values were significantly effected ($p < 0.05$) by dietary treatments, sampling time and their interactions (Table 4). Based on the mean values, the maximum ($p < 0.05$) pH values were observed at 0 time, while the minimum values ($p < 0.05$) observed at 2 hrs post feeding as shown in fig 1. However, most of pH values obtained herein at all measuring times were within the range of 6-7 by (Prasad *et al*, 1972) for optimum cellulytic bacteria activity.

The highest VFA concentrations ($p < 0.05$) occurred in rumen liquor (RL) of animals fed SBM rations (R2 and R3), while R1 showed the lowest ($p < 0.05$) VFA, s concentration (fig 2). The highest ($p < 0.05$) levels of VFA, s were observed at 4 and 8 hrs post feeding and lowest value ($p < 0.05$) was occurred at 0 time prefeeding. The 3rd ration showed the highest ($p < 0.05$) concentration of the VFA, s at most of sampling times, while R1 had almost the lowest ($p < 0.05$) VFA, s concentration. Topps (1964) found that both digestibility and protein content of the ration had a significant effect on the concentration of VFA in the rumen liquor. Also, Topps (1995) stated that forage legumes increase the total concentration of VFA without affecting the relative proportion and the rumen pH, indicating that forage legumes are likely to maintain a stable fermentation pattern.

Hussein *et al.* (1995) showed that ruminal concentrations of VFA were highest ($P < 0.05$) when SBM diet was fed and then decreased ($P < 0.05$) linearly with increasing roasting time of SBM indicating a decrease in extent of ruminal degradation of CP and deamination of AA. Hoover (1986) noted that branched-chain VFA and valerate or their precursors (amino acids) should be available as a chemical factor that may influence ruminal fiber digestion.

Rations containing SBM (R2 and R3) showed were increased ($P < 0.05$) in ruminal NH3-N concentration compared to R1 (fig 3) it is of interest to note that the level of NH3-N in RL was positively as associated with CP content in the rations (Table 4). The highest level ($P < 0.05$) of NH3-N was observed at 2 hrs post feeding, while the lowest value was observed 4 hrs post feeding. The concentration of NH3-N in RL at any giving time is a function of its production, utilization by rumen microbes, absorption across the ruminal wall and passage to the lower gut and depends on the ratio between roughage and concentrate in the ration as well (Mehrez, 1992).

The ideal N-concentration in the rumen for microbial protein synthesis per unit of substrate fermented has been variously stimulated at 6-7 mg/100 ml (Satter and Slyter, 1974). Forage legume are relatively good sources of degradable N and rumen population of cellulolytic microbes (Topps, 1995). If N, as any other nutrient, is lacking then the amount of microbial protein synthesized will be limited (Slyter *et al*, 1979) and rate of fermentation in the rumen will be slow (Mehrez *et al*, 1977).

Hussein *et al* (1995) found that the ruminal concentration of NH3-N was lower ($P < 0.05$) when steers were fed the control diet than when fed the

SBM diet. Adding the SBM to the control diet resulted in the highest ruminal concentrations of NH3-N.

Hoover (1986) reported that 95% of the maximal growth rate of most ruminal fiber digesting bacteria was attained at NH_3-N concentration of 1.4 mg/dl and studies have shown the concentrations between 1 and 6 mg/dl are needed. He reported also, that replacing high ruminally degradable protein with low degradable protein supplements eliminated the negative effects on fiber digestion that were associated with feeding high ruminally degradable protein supplements.

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

Items Parameters	Hours	Ration 1	Ration 2	Ration 3	± SEM	Mean
pH-Values	0	7.32	7.35	6.98	0.23	7.22[a]
	2	6.32	6.07	5.96		6.12[b]
	4	7.00	5.99	5.95		6.31[b]
	8	6.87	6.10	6.33		6.43[b]
	+ SEM					0.13
	Mean	6.88[a]	6.38[b]	6.31[b]	0.11	
Total VFA's (ml eq/100ml)	0	11.60	14.70	14.17	1.59	13.49[c]
	2	11.80	16.00	22.20		16.67[b]
	4	15.70	21.57	24.17		20.48[a]
	8	18.17	22.23	25.83		22.08[a]
	+ SEM					0.92
	Mean	14.32[c]	18.63[b]	21.59[a]	0.80	
NH$_3$-N (mg/100ml)	0	4.95	9.61	12.97	0.71	9.18[b]
	2	10.84	10.99	10.81		10.88[a]
	4	7.16	7.29	6.63		7.03[c]
	8	6.49	8.88	9.01		8.13[bc]
	+ SEM					0.41
	Mean	7.36[b]	9.19[a]	9.86[a]	0.36	

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

Concerning blood metabolites, data in Table (5) showed that the highest serum total protein concentration (P<0.05) (8.43 g/100 ml) was recorded with R2, while the lowest value (P<0.05) was noticed with R3 (6.43 g/100 ml), but the differences between rations R2 and R1 or R3 and R1 were not significant. Globulin concentration has the same trends of total protein concentration. Urea-N concentration was the highest (P<0.05) (20.43 mg/100 ml) in the serum of calves fed on R3 than those fed on R1 or R2.

The concentration of Urea-N in blood is affected not only by dietary intake of digestible crude protein in the rumen but also by balance between energy and protein in the diet (Hoffman and Steinhofel, 1990). Increasing the intake of digestible CP or digestible CP/MJ of metabolizable energy increases the urea content in blood (Hoffman and Steinhofel 1990) and (Grings *et al*, 1991).
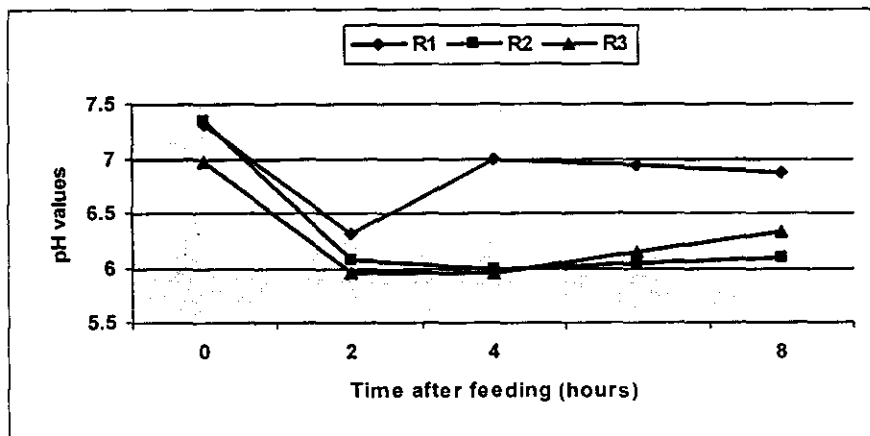
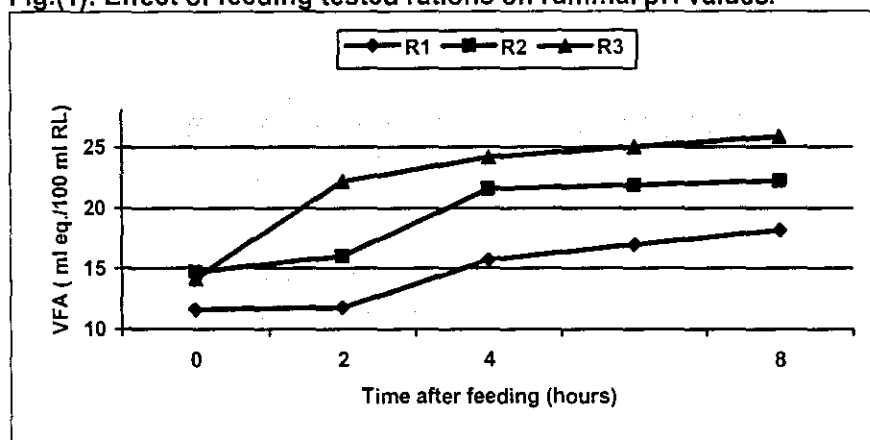**Fig.(1): Effect of feeding tested rations on ruminal pH values.**

Fig.(2): Effect of feeding tested rations on ruminal total VFA (ml. eq. /100 ml RL) values .
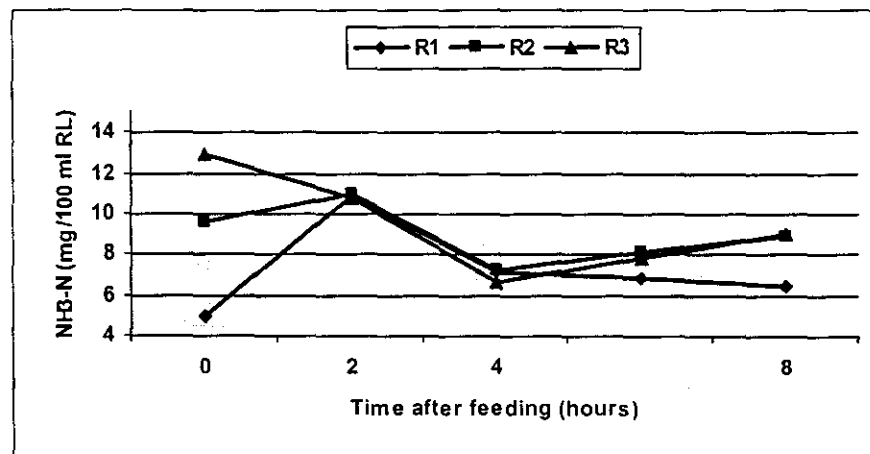

Fig.(3): Effect of feeding tested rations on ruminal NH3-N (mg/100 ml RL) concentration .

Blood parameters:

Table (5): Effect of experimental rations on some blood constituents

Items	Experimental rations			± SE
	Ration 1	Ration 2	Ration 3	
Total protein (t.p.) g/100ml	6.83^{ab}	8.43^{a}	6.43^{b}	0.47
Albumin g/100 ml	3.35	3.55	3.37	0.17
Globulin g/100 ml	3.38^{ab}	4.88^{a}	3.06^{b}	0.45
Creatinine mg/100 ml	1.56	1.57	1.66	0.23
Urea-n mg/100 ml	16.37^{b}	17.50^{b}	20.43^{a}	0.83
GOT IU/L	61.67	60.33	61.67	2.62
GPT IU/L	18.67	22.67	24.00	1.91
GOT/GPT ratio	3.30	2.66	2.57	0.32
Glucose (mg/100 ML)	60.75^{b}	62.37^{b}	73.33^{a}	2.01

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

The presented data was in the normal range as described by Mohamed and Selim (1999) for total protein (5.7- 8.1 g/100 ml), globulin (3.6-4.5 g/100 ml) and urea (6- 27 mg/100 ml) in serum of cattle.

The glucose concentrations in the blood serum were significantly affected by the treatments, and the presented data showed higher (P<0.05) concentration with R3 than R1 or R2. Fouad (2002) and Fouad *et al.* (2002) found that the increase in serum glucose may be attributed to the increase of carbohydrate metabolism and the increase in the rate of intestinal glucose absorption.

Average body weight gain and feed conversion:

Table (6) shows the effect of feeding tested rations on the ABW, DMI kg/d and DMI kg/kg daily gain. The average final body weight was the highest (P<0.05) with feeding calves on R3, while the lowest ABW was when animals fed on R2, but the difference between R1 and R2 or between R1 and R3 were not significant. The ADG was higher when animals were fed R3 than those fed R1 and R2.

The feed conversion (DMI kg/kg daily gain) was improved (P<0.05) when feeding on R2 or R3 than feeding on R1 during 9- 10 month of the age, while the feed conversion was improved (P<0.05) when animals were fed on R1 or R3 than R2 during 10 - 11 month of the age.

Generally, the ADG kg and feed efficiency were higher when animals fed on R3 than feeding on R1 or R2 during 8 - 13 months of the age.

Table (6): The effect of feeding tested rations on the average body weight kg, average daily gain kg, dry matter intake kg/kg daily gain of the growing Friesian calves.

Age month	BW			±SE	ADG			±SE	DMI kg/d			±SE	DMI kg/kg daily gain			±SE
	R1	R2	R3		R1	R2	R3		R1	R2	R3		R1	R2	R3	
Initial BW (8 mo)	152	141	158	6.18	-	-	-	-	-	-	-	-	-	-	-	-
8-9 mo.	176	162	181	6.75	0.78	0.70	0.75	0.05	4.01	4.03	4.17	0.17	5.14	5.76	5.56	0.43
9-10 mo.	202	194	213	8.05	0.87^b	1.06^a	1.09^a	0.06	4.87	5.01	5.07	0.14	5.60^a	4.77^b	4.65^b	0.22
10-11 mo.	226	213	238	8.97	0.78^{ab}	0.61^b	0.83^a	0.06	5.15	5.26	5.67	0.25	6.60^b	8.62^a	6.83^b	0.50
11-12 mo.	245	236	266	9.78	0.69	0.78	0.91	0.73	6.11	5.75	6.27	0.30	8.86	7.37	6.89	0.69
Final BW (12-13 mo)	266^{ab}	255^b	290^a	9.66	0.65	0.63	0.81	0.07	6.98	6.45	7.32	0.33	10.74	10.24	9.04	1.15
8-13 mo.	-	-	-	-	0.76	0.76	0.88	0.03	5.42	5.30	5.70	0.23	6.97	6.97	6.45	0.33

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

Ørskov (1977) reported that microbial protein production in the early weaned ruminant may not be sufficient to sustain maximum rate. These animals should respond to an increased UDP supply provided that AA composition of the protein is appropriate. Calves older than 12 weeks and weighing up to 200 kg had better body weight gain (Amos, 1986) and feed efficiency (Swartz et al, 1991) when fed diets of high UDP content. The NRC (1989) recommends UDP levels of 84.7, 69.5, 57.8 and 48.4% for large breed growing male calves of 100, 150, 200 and 250 kg live weight respectively.

As shown in Table (7), the production efficiency was higher when feeding on R3 than R1 and at last when animals were fed on R2 .

Table (7): Production efficiency of growing calves fed the experimental rations.

Item	Ration 1	Ration 2	Ration 3
DM intake	5.42	5.30	5.70
ME Mcal/kg	2.15	2.3	2.39
MEI Mcal/d	11.7	12.2	13.6
NEm Mcal/day	6.71	7.02	7.85
NEp Mcal/day	4.94	5.17	5.78
Live weight kg	266	255	290
ADG kg/day	0.76	0.76	0.88
Retained energy Mcal/d	2.00	1.98	2.47
Production efficiency	40.5	38.3	42.8

Improved productivity and biological efficiency have significantly (p<0.05) increased the profitability of animal enterprise. (Allaire and Thraen, 1985). Energetic efficiency is the measure of biological efficiency, because energy is most limiting nutrient, and because energy is the nutrient for which intake is most closely related to the level of production (Bath, 1985). Furthermore, protein is a form of feed energy and is accounted for in calculations of energetic efficiency. Profitability is defined as the financial return to labor and management, instead, profitability is calculated to show

the relative economic value of changes in productivity and biological efficiency.

The economic efficiency as shown in table (8) was higher for calves fed on R3 than those fed R1 or R2, being (72.1, 74.2 and 87.6%) for(R1, R2 and R3, respectively).

Table (8): Economic efficiency of growing calves fed the experimental rations.

Item	Ration 1	Ration 2	Ration 3
*Price / kg DM (LE)	0.98	0.99	0.99
DMI / kg / d	5.42	5.30	5.70
Total cost (LE) day	5.30	5.24	5.63
Average daily gain kg / d	0.76	0.76	0.88
Price of daily gain (LE)	9.12	9.12	10.6
Profit (LE) as total feed / calve	3.82	3.88	4.93
Economic efficiency %	72.1	74.2	87.6

Market price Pt./kg fresh of: Concentrate feed mixture= 107.5   SBM = 150
clover hay = 50   kg body weight gain = 1200
* According to the DMI from all ingredients during the digestion trials, the price/kg DMI (LE) was calculated to be 0.98, 0.99 and 0.99 for R1,R2 and R3 respectively.

Conclusion

It could be concluded from the previous data that, replacement of CFM by SBM at 11% of total DM intake in ration of growing Frisian calves containing about 16.5% CP, successfully and economically improved feed intake, digestibility and nutritive values of the ration and improved animal performance, compared with the 7.5% of SBM level or control ration.

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تأثير التغذية على مستويات مختلفة من كسب فول الصويا فـــى علائـــق عجـــول الفريزيان النامية على :
١ – معاملات الهضم ، قياسات الكرش ، مكونات الدم والنمو.
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اجرى هذا البحث بهدف دراسة تأثير احلال نسب مختلفة من كسب فول الصويا محل جـزء مـن مخلوط العلف المصنع (٧,٥، ١١%) من المادة الجافة المأكولة الكلية على كل من معاملات الهضم والقيمـــة الغذائية وبعض المعايير لسائل الكرش وبعض قياسات الدم ومعدل النمو فـى العجـول الفريزيـان الناميـة والاستفادة الغذائية والكفاءة الاقتصادية وتم تكوين ثلاث علائق على النحو التالى:
(عليقة اولى) ٦٣ % علف مصنع +٣٧% دريس برسيم.
(عليقة ثانية) ٥٢,٥ % علف مصنع + ٧,٥ % كسب فول صويا + ٤٠ % دريس برسيم.
(عليقة ثالثة) ٤٧ % علف مصنع+ ١١ % كسب فول صويا + ٤٢ % دريس برسيم.
وقد تم تكوين الخلطات على اساس زيادة نسبة البروتين الخام باحلال جزء من مخلوط العلف المصنع بكسب فول الصويا وتراوحت نسبة البروتين بين ١٣,٦ – ١٦,٦ % طبقا لمقررات NRC (١٩٩٦) عنـد تغذيـة العجول النامية بعد الفطام.

استخدم خمسة عشرة عجل فريزيان بمتوسط وزن ١٥٠ كجم عند متوسط عمر حوالى ثمانية اشهر وتم توزيعها عشوائيا الى ثلاث مجاميع (خمسة عجول لكل مجموعة). وبعد اربعة اشهر من بدء التجربـة تم اخذ عينات لاجراء التحاليل المطلوبة لتجارب الهضم واخذ عينات سائل كرش بواسطة اللى المعدى قبـل الاكل وبعد الاكل بــ ٢، ٤، ٨ ساعات لتقدير تركيز ليون الهيدروجين (pH) وتركيـز الامونيـا (NH3) وتركيز الاحماض الدهنية الطيارة (VFA) وتم تسجيل اوزان الحيوانات شهريا لتقدير معدل الزيادة اليوميـة عند التغذية على العلائق المختبرة وحساب الكفاءة الاقتصادية لكل منها.

وكانت أهم النتائج المتحصل عليها كما يلى:
١- تحسنت معنويا معاملات هضم المكونات الغذائية على مسـتوى (٠,٠٥) بـصفة عامـة فيمـا عـدا المستخلص الاثيرى والمكونات الكربوهيدراتية الغير ليفية وذلك عند اضافة كسب فول الـصويا مقارنـة بعليقة الكنترول .
٢-تحسنت معنويا نسبة مجموع المركبات الغذائية المهضومة (TDN) / البروتين الخام (CP) مع العلائـق التى تحتوى على كسب الفول الصويا خاصة العليقة الثالثة (١١% كسب فول صويا)
٣-ارتفعت كمية البروتين المأكولة بالجم لكل وحدة طاقة ممثلة معنويا (٠,٠٥) عند التغذية علـى العلائـق الثانية والثالثة مقارنة بالعليقة الاولى حيث كانت القيم (٦٣,٣٧، ٦٨,٣٥، ٦٩,٧٩ جم بــروتين / ميجـا كالورى طاقة ممثلة عند التغذية على العليقة الاولى والثانية والثالثة على الترتيب)
٤-تحسنت معنويا كل من الطاقة المتاحة المستفاد منها (RFQ ،RFV) ودليل الجودة (QI) على مـستوى (٠,٠٥) عند اضافة كسب فول الصويا للعلائق المختبرة مقارنة بعليقة الكنترول.
٥-اظهرت النتائج زيادة معنوية لكمية الاحماض الدهنية الطيارة الكلية على مستوى (٠,٠٥) عنـد التغذيـة على العلائق الثانية والثالثة مقارنة بالعليقة الاولى.
٦-زاد تركيز الامونيا معنويا (٠,٠٥) بسائل الكرش عند التغذية على العلائق التى تحتوى على كسب فـول الصويا مقارنة بعليقة الكنترول كما زاد تركيز نيتروجين اليوريا بسيرم الدم معنويا (٠,٠٥) عند التغذيـة على العليقة الثالثة مقارنة بالعلائق الثانية والكنترول.
٧-زاد معدل النمو اليومى للعجول معنويا (٠,٠٥) والاستفادة الغذائية عند تغذية العجول على العلائق التـى تحتوى على كسب فول الصويا مقارنة بعليقة الكنترول خاصة عند عمر من ٩- ١١ شهر.
يستنتج مما سبق ان احلال مخلوط العلف المصنع بكسب فول صويا بنسبة ١١% من المـادة الجافـة الكلية المأكولة فى علائق عجول الفريزيان النامية والتى تحتوى على حوالى ١٦,٥% بروتين خـام كانـت الاحسن اقتصاديا وكذلك ادت الى تحسن المأكول ومعاملات الهضم والقيم الغذائية مما ادى الى تحسـن فـى انتاج الحيوانات وذلك مقارنة بالعلائق التى تحتوى على ٧,٥% كسب فول صويا او الكنترول.