J. Agric. Sci. Mansoura Univ., 29(9): 4887 - 4901, 2004

INFLUENCE OF VARYING LEVELS OF DIETARY ENERGY AND FEED INTAKE ON FATTENING PERFORMANCE OF FRIESIAN CALVES USING TMR FEEDING SYSTEM.

Mostafa, M. R. M.[1] ; A. S. Shalaby [2]; A. M. Abd El-Gawad [2]
A. M. A . Mohi - Eldin[1] and E. S. Khalil[1]
1. Anim. Prod. Research Institute, Agric. Research Center.
2. Animal Production Dept., Fac. Agric., Cairo Univ.

ABSTRACT

Twenty four Friesian male calves with an average body weight of 265 kg and 12 months age were used in this study. Calves were divided into four similar groups, assigned randomly to four experimental rations. Rations were formulated to be isonitrogenous and had two different energy levels (70 or 60% TDN), within each energy level two different levels of intake (ad-lib or 85% from the ad.lib. level) were given. Corn silage and berseem hey were used as a roughage portion in all rations. Rations were offered to animal's groups by using the TMR feeding system.

Digestion coefficients of all nutrients were significantly (P<0.05) higher for 70%-TDN ration than 60%-TDN ration. Both TDN and DCP were significantly higher with high energy rations compared

with those of low energy ones. Intakes of DM, TDN and DCP were significantly (P<0.05) higher with low than high energy rations. Final LBW showed marked improvement by increasing level of dietary energy and feed intake, but the differences were not significant between *ad.lib.* and restricted levels for the same TDN level, and between high energy-restricted and low energy-*ad-lib.* rations. The high-energy rations, regardless to level of feed intake, achieved more efficient feed utilization and better feed conversion than the low-energy rations in terms of DM, TDN and DCP. Feeding 85% of *ad-lib.* caused an improvement in feed efficiency under the two levels of energy, but the differences were not statistically significant. Increasing the level of dietary energy and feed intake decreased (P<0.05) pH values and concentration of NH3-N, and increased (P< 0.05) TVFAs concentrations at all sampling times. The *ad-lib.* level had higher (P< 0.05) TVFA's concentration than the restricted feeding level (85%). Concentration of total protein, albumin, glucose and activity of GOT and GPT in plasma increased (P<0.05) and concentration of cholesterol decrease (P<0.05) by increasing level of energy or feed intake. The highest economic efficiency (169%) was obtained for calves fed 85% of ad.lib.high energy ration.

Keywords: Calves, TMR, TDN, digestibility, growth, rumen, blood.

INTRODUCTION

One of the newest feeding systems for feedlot is called "Total Mixed Ration" (TMR). It offers the opportunities to stabilize the rumen media and consequently the digestion going on much efficiently even at high plan of nutrition and over all improves feedlot cattle performance (Coenen, 1996 and McAllister *et al.*, 1999). There is little published information concerning the effect of plan of feeding. A major objective of animal science is to develop feasible strategies to reduce fat accretion during growth of beef animals. The important nutritional factors that significantly affect beef cattle performance and its carcass and meat quality are levels and sources of dietary energy (Aronen *et al.*, 1992, Kirchgessner *et al.*, 1993. and Mostafa et al., 1993). The objective of this study was to determine the effects of different levels of feed intake and dietary energy levels, using TMR feeding system, on growth and fattening performance of Friesian bulls.

MATERIALS AND METHODS

The practical work of this study was carried out at Animal Nutrition Research Unit, Sakha Animal Production Research Station, belonging to Animal Production Research Institutes, Ministry of Agriculture, Kafr El-Sheikh Governorate.

Experimental groups:

A total of 24 Friesian calves were divided into four similar groups (6 in each) according to their live body weight. Calves in each group averaged 265 kg LBW and 12 month of age at start of the experiment. Rations were formulated to be isonitrogenous and had different energy levels (70 or 60% TDN). Corn silage and berseem hay were used as a roughage portion in all rations. Within each energy level, two different levels of intake (*ad-lib.* or 85% form the *ad-lib.* level) were applied. Animals in all groups were fed the formulated rations and kept under semi-open sheds through an experimental period of 225 days.

The ingredients of the experimental rations are presented in table (1) and their chemical composition in table (2). The calculated composition of the diets also are recorded in the later table. Roughage :concentrate ratios were 23:77% in 70% TDN rations and 36:64% in 60% TDN rations.

Rations were offered to animal groups by using the TMR feeding system according to NRC (1984) requirements for growing calves. All ingredients of the experimental rations were homogeneously mixed immediately prior to feeding through the feed mixer machine. Calves were fed the tested rations where the TMR feeding system was employed and the allowanced rations were offered two times a day. Fresh water was offered to animals three times a day.

Digestibility trials:

Four digestibility trials were conducted simultaneously with the same calves of the feeding trials (three animals in each group) after three months of feeding animals the experimental rations to determine the digestion coefficients and the nutritive values of the tested rations.

Table (1): Ingredients percent of the experimental rations on DM basis:

Feed stuffs	70% TDN		60% TDN	
	Ad-lib.	85%	Ad-lib.	85%
Concentrate mixture *	32.16	32.16	64.00	64.00
Yellow corn	31.80	31.80	-	-
Soybean meal	12.95	12.95	-	-
Berseem hay	6.45	6.45	32.07	32.07
Corn silage	16.64	16.64	3.93	3.93

*** Concentrate mixture (16% CP) consisted of 32% undecorticated cotton seed cake, 5% linseed cake, 22% yellow corn, 26% wheat bran, 12% rice bran, 2% molasses, 0.5% lime**

stone, and 0.5% common salt.

The duration of each digestibility trial consisted of 15 days as preliminary period followed by days collection period. Calves were fed their daily feed allowances according to the experimental design assigned of each group over the feeding trial. Acid Insoluble ash (A.I.A.) was used as a natural internal marker. Animals were fed individually and feed intake was daily recorded. Fecal samples of nearly 200 g were taken from the rectum twice daily at 8 am and 8 pm during the collection period. The daily samples of feces for each animal were immediately frozen at -20瘵 until the end of the collection phase. Nutrients digestibility were calculated according to Schneider and Flatt (1975). Chemical analysis of feed and feces was determined according to the method of A.O.A.C (1990). Acid insoluble ash was determined according to the method described by Van Keulen and Young, (1977).

Rumen liquor samples and its measurements:

Rumen liquor samples were collected from three calves in each group before feeding (zero time), 2, 4, 6 hours post feeding by using a stomach tube. Ruminal pH values were measured immediately using digital pH meter. Concentration of total volatile fatty acids were estimated as described by Abou-Akkada and El-Shazly (1964). Concentration of ruminal ammonia-N was estimated as described by Conway (1962).

Blood samples:

At the end of the digestibility trials, blood samples were collected into heparinized vacutainer tubes from the jugular vein of six calves in each group 3 h post-feeding. Then, samples were centrifuged for 15 minute at 4000 r.p.m to obtain the plasma that was kept at - 20 °C till analyses. Concentration of total protein was determined as described by Stanbio laboratory Data. Albumin was determined as described by Tietz (1994). While, concentration of plasma globulin was obtained by subtracting the albumin from the total protein concentration. Concentrations of glucose and cholesterol were determined as described by Trinder (1969). Activities of glutamate oxalo-acetate (GOT) and glutamate pyruvate (GPT) transaminases in blood plasma were determined as described by Reitman and Frankel (1957).

Feed conversion and economical efficiency:

Calves were biweekly weighed throughout the experimental period at morning before drinking and feeding. Feed conversion was calculated and expressed in terms of kg DM or TDN required to produce one kg weight gain. The economical efficiency was calculated as the ratio between income (Price of the weight gain) and cost of feed consumed.

Statistical Analysis:

Data were statistically analyzed using general linear models according to ANOVA procedures of SAS (1982). Means were separated using Duncan's multiple range tests (Duncan, 1955) when the main effects were significant.

RESULTS AND DISCUSSION

Chemical composition:

Data in Table (2) clearly indicated that the chemical composition of yellow corn, soybean meal, berseem hay and corn silage that obtained in this study are commonly comparable to those recorded in the literature.

Content of OM and NFE increased with increasing the level of energy in the ration T1 and T2 While, CF and ash contents increased with decreasing the level of energy in the rations (T 3and T4).

Table (2): Chemical composition of the dietary ingredients and calculated composition of the experimental rations.

Item	DM%	Composition of DM %					
		OM	CP	CF	EE	NFE	Ash
Fed ingredients:							
CFM	90.9	91.90	16.40	12.33	3.72	59.45	8.10
YC	89.9	98.50	8.55	2.66	3.02	84.27	1.50
SBM	91.5	92.04	39.98	7.88	1.48	42.70	7.96
BH	91.1	90.72	13.32	26.30	2.79	48.31	9.28
CS	33.6	90.97	7.45	17.32	2.55	63.65	9.03
Chemical composition of experimental rations (calculated):							
R1(T1&T2)	70.7	93.80	15.27	10.41	2.95	65.16	6.21
R2(T3&T4)	85. 3	91.49	15.06	17.01	3.37	56.05	8.51

Percentage of crude protein was nearly similar in high and low energy rations, being slightly higher than that recorded in NRC (1980) for growing fattening calves.

Digestion coefficients:

Digestion coefficients of all nutrients were significantly (P<0.05) higher for 70 than 60% TDN rations, regardless of feed intake level (Table 3). These results are in agreement with those obtained by Soliman (1971) and Mostafa et al. (1993), who found that increasing dietary energy level led to an increases in digestibility of DM and OM. Abou-Raya et al. (1987) showed that the digestion coefficients of all nutrients increased with increasing the level of concentrate feed mixture in the ration from 1 to 1.5% of the animal's LBW. It is of interest to note that CF digestibility was significantly higher (P<0.05) for high energy rations than those of low energy ones. This is in agreement with the results obtained by El-Sayes et al., (1997), who found that CF digestibility was increased as energy level in the diet increased by 20-30% with growing buffalo calves. The higher digestibility of CF with the higher energy rations (70% TDN) might be attributed to a positive mutual associative effect inter-ingredients of the experimental rations. Also, these quantities and the proportions of clover hay and corn silage in these rations (Table 1) probably caused another kind of positive effect on CF fermentation in the rumen (Hussien and Berger, 1995 and Mohamed et al., 1999). Moreover, the chemical nature of fiber (mainly its content of cellulose, hemicellulose and lignin) in any forage affect greatly its digestibility of fiber and the other nutrients (protein, fat and carbohydrate) and energy utilization (Raharjo *et al.*, 1986).

Table (3): Digestion coefficients and feeding values of the experimental rations fed by Friesian calves.

Item	70% TDN		60% TDN	
	Ad-lib.	85%	*Ad-lib.*	85%
Apparent digestibility %:				
DM	70.72a	68.63b	65.63c	64.49c
OM	74.23a	72.55b	67.18c	65.49c
CP	73.93a	70.60b	67.15c	64.97d
CF	60.59a	58.77b	55.77c	53.90d
EE	75.45a	73.26b	71.21bc	70.65c
NFE	76.41a	75.70a	70.44b	68.85b
Feeding values %*:				
TDN	72.38a	71.10a	64.70b	61.99c
DCP	11.29a	10.78b	10.11c	9.78d

a, b, c and d: Mean in the same row with different superscripts differ significantly (P<0.05). * Based on DM basis.

Concerning the effect of levels of intake, all nutrients digestibility were significantly (P<0.05) higher with the ad.lib. ration than those of 85% intake ration, particularly on 70% TDN rations level than those given 85%. This indicated that the restricted feeding regime by 85% of the ad-lib. standard did not increase the digestibility of dry matter and its nutrients but the vice versa occurred. These results are in agreement with those obtained by Albin and Durham (1967). Generally, the relationship between feed intake and digestibility is negative; (Tyrrel and Moe, 1975).

Feeding value:

Regarding feeding value, presumably both trends and values of nutrients digestibility among treatments were ultimately reflected on its TDN and DCP values. Data in Table (3) show that both TDN and DCP were significantly higher with high-energy ration compared with those of low energy level. These results are in accordance with those obtained by Nagah (2002), who found that the 120% energy level recorded higher (P<0.05) TDN value by about 10.9% than that of 100% energy level. Consistently with this findings, Mostafa *et al.*, (1993) and Taie *et al.*, (1998) found that TDN and DCP values significantly increased as the level of concentrates increased and roughage portion decreased.

Dry matter intake:

Intakes of DM, TDN and DCP were significantly (P<0.05) higher with low than high-energy rations table 4. These might be due to palatability of the high percentage of clover hay inclusion (32.07%) in these low energy rations and/or probably due to the high portion (64%) of concentrate mixture as well (Table 2). These results are in harmony with those obtain by Nelson *et al.*, (1980), who found that DM consumption was somewhat greater for steers grown on low energy. Also, Sehjpal *et al.* (1980) found that DM intake decreased by increasing level of dietary energy. According to the present results, it could be noticed that the feed intake are covered DM, TDN and DCP requirements of the experimental animals for all dietary treatments even those had the 85% restricted rations as compared with NRC (1984) requirements.

Live body weight gain:

Results of growth performance in Table (5) indicated that final LBW of calves showed marked improvement by increasing levels of dietary energy and feed intake, but the differences were not significant between *ad-lib.* and restricted levels for the same TDN level, and between high energy-restricted and low energy-*ad-lib.* rations.

Table (4): Average daily feed intake of Friesian calves fed the experimental rations.

Item	70% TDN		60% TDN	
	Ad-lib.	85%	*Ad-lib.*	85%
Fed consumption (kg/h/d) from:				
CFM*	3.20	2.72	7.35	6.24
Yellow corn*	3.20	2.72	-	-
Soybean meal*	1.28	1.09	-	-
Berseem hay*	0.64	0.54	3.67	3.12
*Corn silage**	4.48	3.80	1.22	1.04
Total DM (kg/h/d)	9.04b	7.68c	10.44a	8.87b
Kg DM/100 kg LBW	2.25	1.97	2.73	2.40
G DM /kg $W^{0.75}$	100.88	87.62	120.60	105.05
TDN intake:				
Kg/h/d	6.54a	5.46b	6.75a	5.49b
Kg 100 kg LBW	1.63	1.40	1.76	1.48
G kg $W^{0.75}$	72.98	62.29	77.97	65.02
DCP intake:				
G/h/d	1.021a	0.830b	1.055a	0.870b
Kg 100 kg LBW	0.25	0.21	0.28	0.23
G kg $W^{0.75}$	11.39	9.47	12.19	10.30

a, b and c: Means in the same row with different superscripts differ significantly ($P<0.05$). * As fed

Table (5): Live body weights, total weight gain and average daily gain of Friesian calves fed the experimental rations.

Item	70% TDN		60% TDN	
	Ad-lib.	85%	*Ad-lib.*	85%
Initial body weight (kg)	265	265	265	265
Final body weight (kg)	511.83^{a}	493.00^{ab}	486.0^{bc}	467.33^{c}
Total gain (kg)	246.83^{a}	228^{ab}	221^{ab}	202.33^{b}
Average daily gain (kg)	1.097^{a}	1.013^{ab}	0.892^{ab}	0.899^{b}

a,b,c: Means in the same row with different superscripts differ significantly ($P<0.05$)

Calves fed high energy *ad-lib.* ration showed significantly the heaviest weight, while those fed low energy-restricted ration showed the lightest weight. Also total gain and average daily gain were not affected significantly by level of feed intake for the same level of energy, but the differences were only significant ($P<0.05$) between calves fed high energy-*ad-lib.* and those fed low energy-restricted ration. This indicated interaction effect of energy level with feed intake level on total gain and ADG of calves (Table 5).

These results are similar to those obtained by Prior *et al.* (1977) and Sarma and Sharma (1979), who found that average daily gain showed a linear increase ($P<0.01$) as the levels of energy intake increased. Consistent with this trend, Mostafa *et al.*(1998) reported that ADG of buffalo calves markedly increased as TDN level in the rations increased from 57% to 66%. Also, Taie *et al.* (1998) found that feeding high energy diets resulted in greater daily body weight. Moreover, Nagah (2002) found that both final body weight and ADG were lower for the 100% energy level than that of 120% energy level.

Concerning the effect of restricted feeding system on daily gain, similar results were obtained by Hicks *et al.* (1990), who observed reductions in yearling steer ADG by 7.4% when the intake was restricted to 85% of the *ad-lib.* Also, Murphy and Loerch (1994) revealed that ADG reduced by 8.1 and 14.1% for steers given 90 and 80% of the *ad-lib.* level compared with their control of *ad-lib.* access to feed.

Feed efficiency:

Results in Table (6) revealed that the high-energy rations, regardless of the level of feed intake, achieved more efficient feed utilization and better feed conversion than the low-energy rations in terms of DM, TDN and DCP. Concerning level of feed intake, the 85% of *ad-lib.* feed intake caused an improvement in feed efficiency under the two levels dietary of energy, but the differences were not statistically significant.

Table (6): Feed efficiency and feed conversion of calves fed different experimental ration

Item	70% TDN		60% TDN	
	Ad-lib.	85%	*Ad-lib.*	85%
Feed efficiency:				
Kg gain /kg DM	0.122	0.132	0.094	0.101
Kg gain /kg TDN	0.168	0.185	0.145	0.163
Kg gain /kg DCP	1.074	1.220	0.930	1.033
Feed conversion:				
Kg DM/ kg gain	8.24	7.58	10.63	9.86
Kg TDN/ kg gain	5.96	5.38	6.87	6.10
Kg DCP/ kg gain	0.930	0.819	1.074	0.967

The present results are matched with those of Soliman, (1981); Etman *et al.* (1987) and Mostafa *et al.* (1993), who found that feed efficiency increased with increasing the level of concentrate mixture in the ration. Also, El-Says *et al.* (1997) found higher feed efficiency with high energy ration than the control ration. Concerning the results of restriction regime, Old and Garrett (1987) observed a 20% improvement in feed efficiency by steers given their feed at 85% of their *ad-lib.* capacity of intake. Nagah (2002) found that 100% energy levels were insignificantly more efficient than those of 120% level. Also, Hicks *et al.* (1990) reported an improvement in feed efficiency by 8.4% for yearling steers receiving 85% of their *ad-lib.* feed intake, and improvements in feed efficiency by 10.9% for yearling heifers receiving 89% of their *ad-lib.* feed intake. The improvement in feed efficiency by restricting level of feed intake compared with ad-lib feeding may be attributed to: 1) reduced liver size and maintenance energy expenditures, 2) reduced physical activity leading to reduce maintenance requirements, 3) increasing diet digestibility with decreasing intake, and 4) reduced feed wastage.

Rumen Activity:

Mean pH values (Table 7) showed marked decrease in all treatments pre-feeding than that at 2 and 4 hours after feeding. However pH values increased thereafter at 6 hours post-feeding. Data also showed that increasing the level of energy in the ration decreased ($P<0.05$) pH values at all sampling times. These results are in accordance with the findings of Cowsert and Montgomery (1969) and Leventini *et al.* (1990), who found that ruminal pH value decreased with increasing the level of concentrate in the ration. Also, Nagah (2002) registered lower ruminal pH value of 120% energy level than of 100% energy level.

Tale (7): Rumen activity of Friesian calves fed the experimental rations.

	Sampling time, h	70% TDN		60% TDN	
		Ad-lib.	85%	*Ad-lib.*	85%
pH value	0	6.85^{c}	6.88^{b}	6.91^{ab}	6.93^{a}
	2	6.33^{d}	6.58^{c}	6.70^{b}	6.73^{a}
	4	6.14^{d}	6.31^{c}	6.36^{b}	6.39^{a}
	6	6.78^{d}	6.81^{c}	6.88^{b}	6.94^{a}
	average	6.52	6.64	6.71	6.74
NH3-N (mg/100 ml)	0	15.99^{c}	16.14^{c}	16.81^{b}	17.03^{a}
	2	19.83^{c}	20.01^{bc}	20.41^{b}	21.11^{a}
	4	18.71^{c}	18.92^{c}	19.35^{b}	19.82^{a}
	6	17.41^{c}	17.90^{b}	18.60^{a}	18.71^{a}
	average	17.98	18.24	18.79	19.16
TVFA's (meq/100 ml)	0	8.88^{a}	8.61^{b}	7.67^{c}	7.37^{d}
	2	11.00^{a}	10.74^{a}	9.73^{b}	9.24^{c}
	4	13.01^{a}	12.69^{b}	11.63^{c}	11.36^{d}
	6	10.88^{a}	9.95^{b}	9.59^{c}	8.92^{d}
	average	10.94	10.49	9.65	9.22

a,b,c and d: Means in the same row with different superscripts differ significantly ($P<0.05$)

Data in Table (7) showed that concentration of NH3-N was the lowest in pre-feeding samples and increased to their maximum levels at 2 h post-feeding and then decreased again in most treatments at 6 h post feeding. The present results appear marked reduction in concentration of NH3-N by increasing level of dietary energy and feed intake. The trend of changes through sampling times is matched with that recorded by Mostafa *et al.* (2001). Also, Nagah (2002) reported that the higher energy level (120%) recorded lower ($P<0.05$) level of ruminal ammonia nitrogen than of 100% energy level.The lower value of NH3-N associated with the high energy ration might be attributed to the more readily available energy that enhance the pool ammonia-N to convert to microbial protein (Huhtanen, 1987). Moreover, Hungate (1966) demonstrated that rumen microorganisms utilize more NH3-

N when more energy sources are fermented.

Regarding ruminal TVFA's data in Table (7) showed that its concentrations in all groups increased to their maximum at 4 h post-feeding and then reduced again at 6 h of sampling time. These results are in agreement with those obtained by Fayed (1995) and Nagah (2002), who found that the highest concentration of TVFA's was recorded at 4h post-feeding, while the lowest one was noted at zero time. The increases in TVFA's at 4h post- feeding are probably due to the fermentation of unstructural carbohydrates of the ration. The variations in VFA levels among treatments seemed to be somewhat little, however, the significant differences among treatment were observed at sampling times (Table 7). Data showed that the highest (P< 0.05) TVFAs concentrations were found with high-energy rations (70% TDN) compared with the low energy ones (60% TDN) that had the lowest (P<0.05) values. Regarding the level of feed intake, results indicated that the *ad-lib.* level had higher (P< 0.05) TVFA's concentration than the restricted feeding level (85% of the *ad-lib.*).

These results are in agreement with those obtained by Cowsert and Montgomery (1969), who reported that increasing proportion of concentrates or adding starch and soluble carbohydrates in rations for cattle, increased concentration of ruminal TVFAs. De Faria and Huber (1984) indicated that dietary N and energy stimulated rumen fermentative activity, resulting in more VFA's. Generally, Van Soest *et al.*, (1991) cleared that the variation in VFA concentration in rumen was matched with the buffering capacity of feedstuffs (physically and chemically) which derived in part from the physical effects that they elicit in the rumen and on rumination rate.

Blood constituents:

Data in Table (8) show that total protein and albumin concentrations in plasma of calves increased by increasing level of energy or feed intake, being significantly (P<0.05) the highest in calves fed high energy-*ad-lib.* ration and the lowest in those fed low energy-restricted ration. The present total protein concentration in all groups are within the normal range reported by Kaneko (1989), being 6-8 g/dl. Nagah (2002) found that 120% energy level showed higher (P<0.05) total Protein value than (100%) energy level of the animal's requirement. However, Abd El-Wahed (1999) found no significant differences in total protein concentration when concentrate level increased from 1 to 1.5% of lamb's body weight.

In addition, albumin values obtained here are within the normal value being 3.5 to 5.00 g/100 ml (Kaneko, 1989). Nagah (2002) found that the high energy level (120%) gave higher (P<0.05) albumin content in blood plasma than that of 100% energy level of growing lamb's requirements. However, Abd El-Wahed (1999) found no significant differences due to either the different level of energy or the roughage type in the rations of lambs.

Table (8): Blood constituents of Friesian calves fed the experimental rations.

Item	70% TDN		60% TDN	
	Ad-lib.	85%	*Ad-lib.*	85%
Total protein (g/dl)	8.19[a]	7.68[c]	7.99[b]	7.45[d]
Albumin (g/dl)	4.72[a]	4.23[c]	4.49[b]	3.93[d]
Globulin (g/dl)	3.47	3.45	3.50	3.52
Albumin/Globulin	1.35[a]	1.22[c]	1.28[b]	1.11[d]
Glucose (mg/dl)	67.71[a]	65.67[b]	62.92[c]	59.67[d]
Cholesterol (mg/dl)	138.68[d]	144.46[c]	149.71[b]	159.72[a]
GOT (IU/L)	43.71[a]	40.81[b]	38.80[c]	40.87[b]
GPT (IU/L)	25.82[a]	23.78[b]	21.59[c]	19.65[d]

a,b,c and d: Means in the same row with different superscripts differ significantly ($P<0.05$)

Concentration of globulin in plasma of Friesian calves fed the experimental rations did not differ significantly among the experimental groups. The present values of globulin are within the range (1.5-6.0 g/dl serum) obtained by Fouad *et al.*, (1975). Due to the different concentrate levels or different kinds of roughages in lamb's rations, Abd-El-Wahed (1999) found insignificant differences in globulin concentration. Albumin to globulin ratio showed similar trend of change in total protein and albumin concentration in blood plasma of Friesian calves fed the experimental rations (Table 8). These ratios are within the range obtained by Metwally *et al.* (1999) ranging between 1.08 and 1.30.

Regarding the concentration of glucose and activity of transaminases (GOT and GPT), they significantly ($P<0.05$) decreased while the concentration of cholesterol significantly ($P<0.05$) increased in blood plasma of Friesian calves by increasing level of dietary TDN and feed intake level (Table 8). These results are within the values obtained for plasma glucose (58.8-69.2 mg/dl) as reported by Kegley *et al.* (1991) on beef steers, and those obtained for cholesterol on Friesian bulls (II4.84and I69.00 mg/dl) as reported by El-Halawany *et al.* (1987).

Results presented here are in accordance with those reported by Gaafar (2002), who found that blood glucose concentration increased with increasing the level of concentrate in the rations. The pronounced increase in glucose concentration by increasing level of concentrates in rations may be related to increased propionic acid production in the rumen and most of the propionic acid that was absorbed from the gut is converted into glucose by liver. Moreover, propionic acid is a precursor for about 80% of glucose synthesized by the liver with amino acids and lactate, which being minor substrates for glucose synthesis (Perry and Cecava, 1995).

Concerning serum blood transaminases (GOT and GPT) activity, the present results are in harmony with those reported by Mehany (1999), who found that plasma activity of GPT and GOT increased with increasing the level of concentrate mixture. Moreover, Nagah (2002) found that GPT and GOT activities were significantly higher with 120% than 100% energy level of animal's requirements.

Economical evaluation:

Data in Table (9) revealed that daily feed cost was significantly (P<0.05) higher for calves fed at *ad-lib. level* than those fed 85% of *ad-lib,* over both TDN levels, being the lowest in restricted intake-low energy ration. The significantly lower daily feed cost and higher ADG of calves fed restricted-high energy level resulted in the highest (169%) economic efficiency (EE). While, those fed *ad-lib.*-low energy level showed the lowest EE (144%).

Table (9): Economic efficiency of the experimental rations used in growing-fatting Friesian calves.

Item	70% TDN		60% TDN	
	Ad-lib.	85%	*Ad-lib.*	85%
Av. Daily gain (kg)	1.097	1.013	0.982	0.899
Daily feed cost (L.E)*	5.60[a]	4.77[b]	5.48[a]	4.63[b]
Price of daily gain (L.E)*	8.78	8.10	7.86	7.19
Economic efficiency (%)	157	169	144	155

a,b: Means in the same row with different superscripts are significantly different (P<0.05)

*** Price of of concentrate mixture, yellow corn, soybean meal, berseem hay and corn silage were,532 ,565, 1080, 385, and 110 LE/ton, respectively. Market price of one kg live body weight was 8 L.E.**

These results are in agreement with those obtained by El-Ashry *et al.* (1988), who showed that calves fed high-energy diet had the least feed cost per kg gain. In addition, Mehany (1999) found that economical efficiency increased by increasing the concentrate on the expense of berseem in the rations. However, Mehrez *et al.* (1983) reported that feed cost per kg gain of buffalo calves fed different levels of concentrate as 1.6, 2.0 or 2.4% of their BW increased with increasing the level of dietary concentrate.

Conclusion:

It can be concluded that feed restriction to 85% of the ad.libitum intake with a relatively high-energy ration seemed to be most suitable and effective regime for fattening bulls.

REFERENCES

Abd El-Wahad, A. R. R. (1999). Studies on green summer forage. M. Sc. Thesis, Fac. of Agric. Moshtohor, Zagazig Univ., Banha Branch.

Abou-Akhada, A. R. and El-Shazly, K. (1964). Effect of absence of ciliate protozoa from the rumen on microbial activity and growth of lambs. Applied Microbiology, 12: 384.

Abou-Raya, A. K. ; Youssef, M. E. S.; Etman, K. E. I.; Talty, Y. I.; El- and Fahmy, A. A. M.; (1987). Supplementing green forages with concentrate for buffalo calves meat production. 1- Effect of feeding Napier and Sordan grasses with concentrate on performance of calves. Agric. Res. Rev., 65.

Murphy, T. A. and Loerch, S. C.; (1994). Effects of restriccted feeding of growing steers on performance carcass characteristics and composition. J. Anim. Sci., 72: 2497.

Nagah, H. (2002). Use of growth promoters (Non-Hormonal) in rations of growing lambs. M. Sc. Thesis, Fac. of Agric. Ain Shams Univ.

Nelson, L. A. ; Hendrix, K. S.; Lemenage, I R. P.; and Petritz, D. C. (1980). Comparison of the effects of hay and corn silage growing diets on performance and economic returns of different steers types. J. Anim. Sci., 51: 554.

NRC (1980). Nutrient requirements of beef cattle. 5th revised ed. National Academy Press, Washington DC.

NRC (1984). Nutrient requirements of beef cattle. 6th revised ed. National Academy Press, Washington DC.

Old, C. A. and Garrett, W. N.; (1987). Effect of energy intake on energetic efficiency and body composition of beef steers differing in size at maturity. J. Anim. Sci., 65: 1371.

Perry, T. W. and Cecava, M. J.; (1995). Beef cattle feeding and nutrition. 2nd ed. Academic Press, Inc, USA.

Prior, R. L. ; Kohlmeier, R. H.; Cundiff, L. V.; Dikeman, M. E.; and Crouse, J. D.; (1977). Influence of dietary energy and protein on growth and carcass composition of different biological types of cattle. J. Anim. Sci., 45: 132.

Raharjo, Y. C. ; Cheeke, P. R.; Patton, N. M. and Souryati ; K. (1986). Evaluation of rice hull as a fiber source for weaning rabbits. J. Appl. Rabbit Res., B: 150.

El-Halawany, R. S.; El-Keraby, F.; Hamed, M. E.; and Metwally, A. M.; 1987. Influence of age and sex on biochemical characteristics on blood serum of Freisian calves from birth till 18 month old. J. Agric. Res. Tanta Univ. 12:1997.

Reitman, S. and Frankel, S. (1957). Am. J. Clin. Path. 28: 56.

Sarma, P. A. ; Sharma, D. P.; Basu, S. B. and Nagrcenkar, R. (1979). A note on Murrah buffalo for meat production. Indian J. Anim. Sci., 49: 570.

SAS (1982). User's Guide Statistics. (SAS Inst., Cary, NC, Releigh).

Schneider, B. H. and Flatt, W. P. (1975). The evaluation of feeds through digestibility experiments. The Univ. of Georgia Press Athens 30602.

Sehjpal, A. K. ; Mehta, A. K. and Rao, M. V. (1980). Growth response to high energy feeding in young buffalo calves. Indian J. Anim. Sci., 50(6): 467.

Soliman, A. S. (1981). Nutritional studies upon the use of Elephant grass in fattening buffalo calves. Ph. D. Thesis, fac. of Agric., Ain Shams Univ.

Soliman, H. S. (1971). Allownaces of starch and protein for fattening lambs. M. Sc. Thesis, Fac. Agric. Ani. Shams Univ.

Taie, H. T. ; Abd El-Rahman, M. M.; Ahmed, B. M. and Awara, S. M. (1998). Effect of dietary energy on digestibility, rumen fermentation gestation kinetics, performance and carcass traits of sheep. First International Conference on Animal Production & Health in Semi-Arid Areas, 1-3 Sept. 1998, El-Arish-North Sinai, Egypt, p. 134.

Tietz, N. W. (1994). Textbook of Clinical Chemistry. 2nd Ed. W. B. Saunders Company, Philadelphia, PA, 703.

Trinder, P. (1969). Ann. Clin. Bio. Chem. 624 Stanbio laboratory data.

Tyrrell, H. F. and Moe, P. W. (1975). Symposium productuion efficiency in the high producing cow. J. Dairy Sci., 58: 1151.

Van Keulen J. and Young, B. A. (1977). Evaluation of acid insoluble ash as a digesibility studies. J. Anim. Sci., 44: 282.

Van Soest, P. J. ; Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fiber, neutural detergent fiber and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3584.

تأثير مستويات الطاقة المختلفة فى العليقة والغذاء المأكول على الاداء الانتاجى لعجول الفريزيان المغذاة بنظام العليقة المتكاملة الخلط

محمد رفاعى مصطفى[1] – عادل صلاح الدين شلبى[2] – عبد الرحمن عبد الجواد[2] عبد الحليم محمد عبد السلام محى الدين[1] - عماد سيد خليل[1]

١- معهد بحوث الإنتاج الحيوانى – مركز البحوث الزراعية – وزارة الزراعة – ج.م.ع

٢ - قسم الإنتاج الحيوانى – كلية الزراعة – جامعة القاهرة.

أجريت هذه الدراسة بوحدة تجارب التغذية بمحطة بحوث الإنتاج الحيوانى بسخا حيث أستخدم فيها ٢٤ عجلا فريزيان بمتوسط وزن ٢٦٥ كجم وعمر ١٢ شهراً ، وقسمت العجول عشوائيا إلى أربعة مجاميع متشابهه (٦عجول لكل مجموعة) حيث غذيت على علائق متماثلة فى البروتين وبمستويين من الطاقة ٦٠% ، ٧٠% مركبات غذائية مهضومة (TDN) ، وتحت كل مستوى من الطاقة قدمت للعجول مستويين من المأكول ١٠٠% ، ٨٥% من حد الشبع، وأستخدم كل من سيلاج الأذرة الكامل ودريس البرسيم لتكوين علائق التجربة مع باقى المكونات من المركزات والتى قدمت بنظام الخلط المتكامل (TMR)، وكانت النتائج كالتالى :

معاملات الهضم كانت أعلى معنويا فى مستوى الطاقة ٧٠% عن ٦٠% سواء على مستوى المأكول حتى الشبع أو ٨٥% من حد الشبع. كل من المركبات الغذائية المهضومة والبروتين المهضوم كانت عالية معنويا مع مستوى الطاقة الأعلى بالمقارنة بمستوى الطاقة الأقل. المأكول من المادة الجافة والمركبات الغذائية المهضومة والبروتين المهضوم كان مرتفعا معنويا مع مستوى الطاقة المنخفض عن مستوى الطاقة الأعلى. الوزن الحى النهائى تحسن بزيادة مستوى الطاقة والمأكول ولكن كانت الإختلافات غير معنوية بين ١٠٠% ، ٨٥% من حد الشبع وذلك داخل كل مستوى من مستويات الطاقة، كما لا توجد فروق معنوية بين كل من الغذاء المرتفع الطاقة والمقدم بنسبة ٨٥% من حد الشبع والغذاء منخفض الطاقة والمقدم بنسبة ١٠٠% من حد الشبع. مستوى الطاقة المرتفع (٧٠%) والمقدم بنسبة ٨٥% من حد الشبع أعطى أحسن تحويل غذائى عن منخفض الطاقة لنفس مستوى المأكول. التغذية على ٨٥% من حد الشبع أدت الى تحسن الكفاءة الغذائية تحت مستويات الطاقة المختلفة ولكن لم تكن هناك إختلافات معنوية. زيادة مستوى الطاقة والمأكول أدى إلى إنخفاض قيم درجات الحموضة (PH) وتركيز الأمونيا وزيادة الأحماض الدهنية الطيارة فى الكرش فى معظم الأوقات معنويا، وأظهرت التغذية على ١٠٠% من حد الشبع إرتفاع تركيز الأحماض الدهنية الطيارة عن ٨٥% من حد الشبع معنويا. فى بلازما الدم زاد معنويا كل من البروتين الكلى والألبيومين والجلوكوز ونشاط إنزيمات GPT, GOT بينما انخفض معنويا تركيز الكلوستيرول بزيادة مستوى الطاقة والمأكول. كانت أعلى كفاءة إقتصادية مع مستوى تغذية ٨٥% من حد الشبع ومستوى الطاقة المرتفع ٧٠% TDN.