Egyptian J. Nutrition and Feeds (2006) 9 (2):159-177

EFFECT OF DIETARY ENERGY LEVEL ON NUTRIEN UTILIZATION, RUMEN FERMENTATION, PRODUCTIVE AND SOME REPRODUCTIVE PERFORMANCE OF PREGNANT BUFFALO HEIFERS.

G. F. Shahin; A. A. Zaki and H. El-Matarawy

Animal Production Research Institute, Ministry of Agriculture, Egypt.

(Received 27/2/2006, accepted 22/6/2006)

SUMMARY

Twenty-Two pregnant buffalo heifers were divided into three groups (G2, G1and G3) fed different dietary energy levels. Iso-nitrogenous rations with three levels of dietary energy (80, 100, 120 %TDN of allowances), respectively. Feeding experiment was started from the first 3 months of gestation till the first 120 days of lactation. Ages and live body weight at the beginning of experimental were (658.75, 715.13 and 653.13 days old and 450.88, 428.43 and 467.25 kg body weight, for G1, G2 and G3, respectively).

Animals received normal and high energy level (G1 or G3) during pre and postpartum period recorded the highest digestibility values of DM, OM, CP, EE and NFE as will as feeding values (TDN and DCP) compared to those fed on 80 % TDN (G2), differences were significant and highly significant, respectively. While, CF digestibility was high significantly ($P<0.05$) improved for low energy level (G2). Daily gain, body condition score of heifers fed normal or high energy levels were significantly ($P<0.05$) better than those fed low energy level. Feed conversion (kg DMI and DCPI / kg gain) was poorer in G2 and G3 than those in G1 at 9 months of gestation. The differences were significant only between G1 and G2. While, feed conversion as TDNI kg / kg gain was better ($P<0.05$) in G2 than in G1 and G3 at 9 months of gestation. Also, animals received normal and high energy level (G1 and G3) recorded ($P<0.05$) average live body weight, live body weight changes, relative change to initial body weight and body condition score at first 1st month after calving, at first 4 month after calving and least number of services per conception, however, treatment (G2) showed the poorest ($P<0.05$) mean values. Dietary energy level did not affect ruminal pH value. Concentration of ruminal NH_3-N and VFA'S were significantly higher for heifers fed normal and high energy level groups (G1 and G3) than that of the low energy level (G2) group. Also, animals received (100 or 120 % TDN) G1 and G3 recorded higher mean body ($P<0.05$) weight just before calving, calf birth weight, placenta weight and fetus liquid weight than those of G2 group (80% TDN). While, those fed (80% TDN) G2 recorded higher mean age at first calving and drop of fetal membrane than those G1 and G3 groups. A shorter interval to the first postpartum estrus, service period and days open were recorded for buffaloes dam of G1 and G3 compared to those fed G2 treatment. At the same time animals fed normal level (G1) recorded higher ($P<0.05$) average daily milk, 7 % FCM, fat, protein, lactose, TS, SNF and Ash yields than those of G2 or G3 treatments (80 % and 120 % TDN) but, milk fat, protein, lactose, TS, SNF and Ash percentages were not significantly (P<0.05) affected by energy levels. Feed conversation (kg DM, TDN and DCP / kg 7 % FCM) was better in (P<0.05) G2 fed (80 %TDN) than in G3 fed (120 % TDN) but did not differ significantly from that of G1 (100 % TDN). At the same time animals fed 100 %TDN (G1) recorded higher relative economic efficiency % than that of G3 (120 %TDN), however, G2 showed the lowest (P<0.05) mean values.

From this study, it could be recommended that normal energy (100 %TDN) diet might be fed to pregnant buffalo heifers and lactating buffaloes at first calving to improve live body weight changes, body condition score, feed conversation, economic efficiency and consequently decrease the number of days on feeding till first calving, average daily milk yield, lowest number of services per conception, shortest interval to the first postpartum estrus, service period and days open.

***Keywords**: energy level, buffalo heifers, digestibility, milk yield, performance.*

INTRODUCTION

In Egypt, buffaloes are considered the main source of milk and meat production because they contributed about 60 and 40 % of total milk and red meat production, respectively (Agriculture Economy Research Institute, 1997). Nutrition is a major factor affecting the physiological and metabolic status of buffaloes, thus optimal feeding before calving support the animal to reach parturition in good body condition which insures maximum production and high reproduction efficiency, (El-Ashry *et al.*, 2003). Vandehaar *et al.*, (1999) found that increasing the energy level and protein density up to 1.6 Mcal of NE/kg and 16 % CP in dairy cow diets during the last month before calving improved nutrient balance of cows prepartum. Feed is the most important cost item for livestock production representing about 70 % of production costs (Borhami and Yacout, 2001 and Abdel-Salam, 2003). Heifers fed the greater amount of energy exhibited larger dominant ovarian follicles at a younger age in comparison with heifers fed the lower amount of energy. Age and weight differ (at puberty) among heifers receiving diets with higher energy content compared with those receiving diets with lower energy content (Bergfeld *et al.*, 1994). However, calving interval exceed > 500 days (Mostageer *et al.*, 1981 and Metry *et al.*, 1994). The long calving interval (> 500 days) is one of the major problems in Egyptian buffaloes breeding. It may be affected by several factors, such as breed, uterine involution and nutritional plan, especially energy level, is the most important factors affecting body weight changes, interval to the first postpartum estrus, service period, days open, number of services per conception, milk yield and composition and economic efficiency. Thus optimal feeding before calving help animals to reach parturition in good body condition insures maximum production and high reproductive efficiency. It is an established fact that high level of feeding during late pregnancy (6-8 weeks) has positive effect on their performance pre and post calving of dairy cows (Dunn *et al.*, 1969; Metry, 1988; Bayoumi, 1995 and El-Ashry *et al.*, 2003). There is general agreement that an increase in energy intake of dairy cows within certain limits, increase milk yield, solid not fat (SNF) and to a lesser extent lactose and decrease milk fat yield (Gordon and Forbes, 1970 and El-Ashry *et al.*, 2003). Marston *et al.* (1992) mentioned that benefits of additional levels of energy supplements in cow weight and condition must be achieved before calving. Zedan (1995) reported that low energy intake and poor body condition after calving delay the return of normal function of the ovaries; conception rate tends to decrease when energy intake is inadequate.

El-Ashry *et al.* (2003) concluded that buffalo group fed ration containing 120% energy level and 87.5 % protein level showing highest milk production and best feed efficiency without any adverse effects on performance of buffalo. The first calf-heifers are most often affected by energy deficiencies, in most cases; normal reproductive function is restored when addition grain is provided. Therefore it is important to provide adequate nutrients, especially energy during the first lactation season. Nutritional components, especially energy level, is the most important factor affecting digestibility, body weight, body condition score, feed conversion, rumen fermentation, calf birth weight, age at first calving (Hancock *et al.*, 1985; Houghton *et al.*, 1990; Bayoumi, 1995; Zedan, 1995; Manninen and Huhta, 2001 and El-Ashry *et al.*, 2003).

It seems that score information exists on the utilization of diets with different energy levels on production and reproductive performance of buffaloes in Egypt.

MATERIAL AND METHODS

This study was conducted at El-Gemiza Experimental Station belonging to Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture Egypt.

This study started using twenty-four growing buffalo heifers with mean age and weight of 215 days old and 153 Kg live body weight till age at first service animals were allotted randomly into three similar groups of eight heads each. The experimental rations were iso-nitrogenous with three levels of dietary energy (80, 100 and 120 % TDN) according to Kearl, (1982). Twenty four growing buffalo heifers (7 month and 153 kg body weight) at the beginning of the first part of experimental was published Shahin, 2004[a]. However, the mean ages and live body weight at the beginning of 2[nd] experimental treatments were 365, 356 and 371 Kg live body weight and 17.60, 19.37, 17.20 months till age at 3 months of gestation of buffalo heifers in G1, G2 and G3, respectively, Shahin, 2004[b]. The three experimental treatments was started only twenty-Two pregnant buffalo heifers with mean weight and age of 450.88, 428.43 and 467.25 kg and 21.96, 23.84, 21.77 months, each animal group was fed one of the following experimental treatments, 1[st] group was fed 100 % TDN (G1), while those in the 2[nd] and 3[rd] groups (G2 and G3) were fed 80 and 120 % TDN, respectively, according to Kearl, (1982). The experimental rations were iso-nitrogenous with three levels of dietary energy. Feeding experimental was started from the first third month of gestation tell the first 120 days of lactation.

The experimental animals were fed concentrated feed mixture (CFM), berssem hay (BH), yellow corn (C), and rice straw (RS). The CFM was individually weighed for each animal and offered twice daily at 7.0 a.m and 4.0 p.m. While roughage was offered at

8.0 a.m. and 5.0 p.m. Roughage: concentrate ratio was 60 to 40. Mineral block and fresh water were available freely through the experimental period. All experimental animals were kept under semi-open sheds, daily feed intake was individually recorded, while body weight of each heifer was biweekly recorded before morning feeding. Throughout the feeding period, body condition score (BCS) as changes in live body weight were monthly recorded for each animal (Ebrahim, 2004). Feed allowance was adjusted biweekly according to the change in body weight. Weight of dams, newborn calves was immediately recorded after calving and placenta after expulsion. Buffalo cows were hand milked twice daily at 7.0 a.m and 4 p.m. Daily milk yield of each animal was recorded from parturition up to 120 days postpartum. Animals were observed for estrous twice daily, at 7 a.m. and 4 p.m. Chemical analysis of different feedstuffs and calculated chemical compositions of experimental rations are presented in Table (1). Ruminal fluid samples were collected at the start of the experiment from all animals using stomach tube attached to a vacuum pump, before feeding then at 4 and 6 hrs after feeding, the pH was measured immediately after rumen sample collection using a digital pH meter. Rumen fluid was strained through four layers of cheesecloth into plastic containers and kept for later analysis.

Two digestibility trials were conducted during pre and postpartum periods by using three animals in each experimental groups, individual feeds and fecal grab samples were collected for a 3-d period and composted for each animal to determine total tract apparent nutrients digestibility using acid insoluble ash (AIA) technique as internal marker according to Van-Keulen and Young (1977). Feed intake and conversion during pre and postpartum were calculated. Feed and fecal samples were chemically analyzed according to the methods of A.O.A.C. (1995). Data were statistically analyzed according to SAS, (1995). Differences among means were evaluated using Duncan's test (1955).

RESULTS AND DISCUSSION

Nutrient digestibility:

Data in Tables (2 and 3) showed that animals fed 120% TDN (G3) recorded highest ($P<0.05$) digestibility values of DM, OM, CP, EE and NFE compared to those fed (G2). Moreover, animals fed (G3) significantly showed the highest ($P<0.05$) digestibility coefficients of DM, OM and EE compared to those fed either G1 during prepartum period, but did not differ significantly than those fed 100%TDN (G1) during postpartum period. Digestibility of CF was significantly ($P<0.05$) improved for low energy level (G2) among animals prepartum and postpartum. This may be attributed to increase rumen microbial activity and differences in rate of digestion. These results are in agreement with those reported by Etman, (1985); Tiwari *et al.*, (1990), El-Ashry *et al.*, (2003) and Shahin, (2004[a,b]) who reported that the increase of dietary energy improved the digestibility of all nutrients expect CF digestibility in buffaloes. On the other hand, results obtained in Table (2 and 3) indicated that the digestibility coefficient for all nutrients during postpartum, were significantly ($P<0.05$) higher than those recorded during prepartum period. This might be

Table (1): Chemical analysis of feed stuffs and calculated chemical composition of tested rations.

Feed stuffs:	DM%	Chemical analysis (%) on DM basis					
		OM	CP	CF	EE	NFE	Ash
CFM	88.90	92.51	16.06	12.02	3.23	61.20	7.49
Corn	88.76	97.91	8.61	2.76	3.11	83.43	2.09
Rice Straw	89.79	79.62	3.19	35.36	1.67	39.40	20.38
Berseem hay	88.93	86.43	12.17	29.07	2.74	42.45	13.57
First experimental rations (prepartum):							
Ration1 (G1)	89.20	87.37	10.29	23.22	2.60	51.27	12.63
Ration2 (G2)	89.27	86.14	10.14	24.76	2.52	48.72	13.86
Ration3 (G3)	89.05	88.74	10.22	21.35	2.66	54.51	11.26
Second experimental rations (postpartum):							
Ration1 (G1)	89.12	87.98	10.37	22.43	2.66	52.52	12.02
Ration2 (G2)	89.21	86.76	10.21	24.00	2.56	49.99	13.24
Ration3 (G3)	89.01	89.34	10.30	20.59	2.74	55.71	10.66

G1: 100% TDN G2: 80%TDN G3: 120% TDN, CFM: concentrate feed mixture (39% yellow corn, 29% undecorticated cottonseed meal, 14% rice bran, 9% soybean meal, 5% vines, 3% limestone and 1% salt).

Table (2): Average DM intake, nutrient digestibility and nutritive values as DM, TDN and DCP of experimental ration determined prepartum.

Item	Experimental group		
	G 1	G 2	G 3
Average LBW, kg	520.33±11.35	493.67±15.41	543.00±10.0
W, $kg^{0.75}$	108.94±1.78	104.71±2.45	112.46±2.74
Average Daily DM intake (kg animal .d.):			
CFM	3.85	4.68	2.38
Corn	1.28	-	3.22
Rice straw	3.85	4.68	2.80
Berseem hay	3.85	2.34	5.60
Total DM intake, kg/animal .d.	12.83^{b}±0.45	11.70^{c}±0.47^{b}	14.00±0.31^{a}
Nutrients digestibility (%):			
DM	63.46^{b}±0.72	60.70^{c}±1.87	67.27^{a}±0.65
OM	66.59^{b}±0.95	63.55^{c}±1.47	69.38^{a}±0.49
CP	68.49^{a}±0.66	64.74^{c}±0.51	69.34^{a}±0.65
CF	51.71^{b}±0.84	57.51^{a}±1.51	48.45^{c}±0.75
EE	66.92^{b}± 0.89	63.77^{c}±1.47	72.57^{a}±0.56
NFE	68.43^{b}±1.27	65.47^{c}±0.33	70.67^{a}±1.28
Feeding value (%):			
TDN	57.62^{b}±0.02	53.53^{c}±0.55	61.03^{a}±0.08
DCP	7.36^{a}±0.07	6.77^{b}±0.05	7.50^{a}±0.07

a , b and c : Group means with different letters within the same row are significantly different at $P < 0.05$, CFM: concentrate feed mixture, LBW: Live body weight.

attributed to different dry matter intake and differences in rate of passage of digesta, which may due to the pregnancy status of animals.

Nutritive values:

On the other hand, results obtained in Tables (2 and 3) indicated that values of TDN and DCP were higher in experimental rations G1 and G3 than that of G2.

This was expected because G1 and G3 contained higher energy level and density consequently digestibility coefficients were significantly higher than of G2. The present values are nearly similar to those obtained by El-Ashry *et al.*, (2003) and Shahin, (2004[a,b]), who reported a liner increase in TDN and DCP with increasing energy density in the diet. However, Kishan *et al.*, (1985) did not show any difference in nutrients utilization when buffalo was fed different energy levels.

Productive performance during prepartum period:

The results of heifer's productive performance are shown in Table (4). Heifers fed 100 or 120 % TDN recorded significantly the higher mean body weight, total gain, daily gain and body condition score at 3and 9 months of gestation meanwhile, heifers fed 80 % TDN (G2) significantly showed the lowest mean values. These results agree with those reported by Al-Deeb *et al.*, (2003); El-Ashry *et al.*, (2003) and Shahin, (2004a,b) who reported improvement growth performance of animals by increasing dietary energy density. On the other hand, Khatkar *et al.*, (1992), Dawson, (1994) and Ebrahim, (2004) found that the body condition score was taken as indicator of change in live body weight of buffaloes.

Feed conversion:

The feed conversion expressed as the amount intake of DM, TDN and DCP required per kg gain (Table 4) showed that the animals fed 100 % TDN (G1) had better fed conversion for DMI and DCPI, followed by G3 (120 % TDN). Heifers fed G2 (80 % TDN) showed the poorest feed conversion values. Feed conversion as TDN intake kg / kg gain was significantly ($P<0.05$) better in heifers fed 80 % TDN (G2) than those of G1 and G3 at 9 months of gestation.

It was reported that feed conversion was improved as the energy density increased in animal diets (Jordanovski, 1993 and Shahin, 2000) and Shahin, (2004[a,b]) who reported that the low energy group consumed significantly more feed per kg live body weight gain than high energy group which is in accordance with the present results.

Live body weight changes; relative changes and body condition score during postpartum period:

Data presented in Table (5) showed that animals received 120%TDN (G3) appeared to show higher ($P<0.05$) live body weight and $W^{0.75}$ just after calving, at 30 and 120 days after calving than those fed 80%TDN (G2). However, animals received 100%TDN (G1) appeared to show after calving lower ($P<0.05$) live body weight and $W^{0.75}$ at 30 and 120 days after calving than the ones receiving 120%TDN (G3). These results were in agreement with those reported by Metry, (1988) and Muinga *et al.*, (1993). Concerning the body weight changes and relative changes (% unit MBS) at 30 days after calving, it could be noticed that animals fed 120%TDN recorded higher significant ($P<0.05$) than (G1) but highly significant than those received

Table (3): Average DM intake, nutrient digestibility and nutritive values as DM, TDN and DCP of experimental ration determined postpartum.

Item	Experimental group		
	G1	G2	G3
Average LBW, kg	530.67±13.12	477.67±29.13	558.67±16.91
W, $kg^{0.75}$	110.57±1.25	102.18±1.65	114.91±2.42
Average Daily DM intake (kg/ animal .d.)			
CFM	3.42	4.10	3.13
Corn	2.05	0.59	3.13
Rice straw	3.42	4.10	2.35
Berseem hay	4.78	2.93	7.05
Total DM intake, kg/h/d.	13.67^{b}±0.17	11.71^{c}±0.17	15.67^{a}±0.17
Nutrients digestibility (%):			
DM	68.27^{a}±0.34	63.78^{b}±0.73	68.67^{a}±0.41
OM	69.71^{a}±1.24	67.39^{b}±0.67	71.22^{a}±0.73
CP	74.77^{a}±0.59	69.80^{b}±0.86	74.11^{a}±0.63
CF	54.80^{b}±0.87	58.65^{a}±0.79	51.43^{c}±0.34
EE	72.26^{b}± 0.72	68.59^{c}±0.49	74.84^{a}±0.58
NFE	70.23^{b}±0.12	68.03^{c}±0.67	73.11^{a}±0.93
Feeding value (%):			
TDN	60.20^{b}±0.60	58.14^{c}±0.56	62.42^{a}±0.48
DCP	7.75^{a}±0.10	7.13^{b}±0.09	7.64^{a}±0.06

a, b and c: Group means with different letters within the same row are significantly different at $P< 0.05$, CFM: concentrate feed mixture, LBW: Live body weight.

Table (4): Growth performance of buffalo heifers fed different experimental rations.

Item	Experimental group		
	G 1	G 2	G 3
Live body weight (kg) at:			
Initial weight	153.50±6.01	153.38±8.32	153.38±4.95
months of gestation - 3	450.88^{b}±9.6	428.43^{c}±11.8	467.25^{a}±6.8
months of gestation - 9	571.25^{b}±9.71	530.59^{c}±13.3	594.43^{a}±12.55
Total body gain from 3-9, kg	120.38^{a}±5.15	101.80^{b}±2.86	125.86^{a}±5.54
Average daily gain , kg	0.669^{b}±0.03	0.565^{c}±0.02	0.700^{a}±0.03
Body condition score at:			
months of gestation - 3	2.58^{b}±0.11	1.98^{c}±0.13	2.82^{a}±0.18
months of gestation - 9	2.75^{b}±0.25	2.30^{c}±0.17	3.18^{a}±0.21
Average feed intake, kg			
DM	12.16^{b}±0. 48	11.66^{c}±0.38	13.37^{a}±0.50
TDN	7.43^{b}±0.28	6.15^{c}±0.20	8.07^{a}±0.31
DCP	0.857^{b}±0.03	0.77^{c}±0.02	0.956^{a}±0.04
Feed conversion :			
Kg DM / Kg gain	18.38^{b}±1.04	20.68^{a}±0.78	19.17^{b}±0.27
Kg TDN / Kg gain	11.12^{a}±0.62	10.88^{b}±0.41	11.52^{a}±0.17
Kg DCP / Kg gain	1.30^{b}±0.07	1.37^{a}±0.05	1.34^{b}±0.02

a , b and c: Group means with different letters within the same row are significantly different at $P< 0.05$.

80%TDN (G2). Also, the body weight changes and relative changes (% unit MBW) at 120 days after calving, it could be shown that increasing energy level from 100 to 120%TDN tended to increase body weight changes and relative changes (% unit MBW) at 120 days after calving than those fed 80 %TDN (G2). However, differences were not significant (P<0.05). Concerning, body condition score, data presented in Table (5) showed that animals received 120%TDN (G3) appeared to show higher body condition score than those fed (G1) significant and high significant (G2) (P<0.05). These results are in agreement with those obtained by Bayoumi, (1995); El-Ashry *et al.,* (2003) and Zaki and Shahin, (2004). This might be attributed to different age; energy level and dry matter intake and differences in body weight changes and relative changes and digestibility of all nutrients.

However, Khatkar *et al.*, (1992), Dawson, (1994) and Ebrahim, (2004) found that the decline in body weight of yielding cows and buffaloes during the early stage of lactating period may be become of mobilization of body reserves for milk production, since 10-15 % of the total energy for milk production comes from body reserves.

Rumen parameters:

To clarify the mode of action of dietary energy level, ruminal microbial activity was evaluated as pH and concentration of ammonia-N and volatile fatty acids (VFA) shown in Table (6). Mean ruminal pH values were declined with all treatment groups to reach the lowest values at 6 hrs of morning feeding. Differences between groups were recorded for group (G2) 80 % TDN being higher for G1 and G3. With time of sampling advancement, pH values tended to decrease at 3 and 6 hours post-feeding , while highest values were obtained at zero time (before feeding). Bach *et al.*, (1999) found that energy supplementation reduced pH. El-Badawi *et al.*, (2001) reported that the lactating cows fed diets contained sugar beet pulp decrease pH after 6 hours.

Before feeding (at zero time) ammonia-N concentration was the lowest with the heifers fed 80 % TDN (G2) group than those fed ether 100 or 120 % TDN G1 and G3 groups at the all time studied. The heifers fed 100 oG120 % TDN groups significantly showed higher (P<0.05) ammonia-N concentration compared to those fed 80% TDN (G2) at all times. After the first three hours, ammonia-N concentration started to decline to reach the minimum at the 6 hrs post-feeding. Chauhan and Chopra (1986) and Bach *et al.*, (1999) reported similar trends. The higher ammonia-N concentration values in G1 or G3 groups may have been due at least in part, to a higher rate of protein breakdown within the rumen or to a better utilization in the energy supplementation and also, the low solubility of nitrogen in the low energy level (G2) and high roughage might have contributed to this effect.

The lowest level was reported before feeding for all dietary treatments. At 3 hr after feeding, heifers fed G1 and G3 (100 or 120 % TDN) ration showed higher VFA concentration followed by those fed G2 (80 % TDN) ration. The same trend was observed at 6 hr. The increase in VFA concentrations at 3 hr post-feeding lead to the decrease in pH values. Bach *et al.*, (1999) concluded similar effect.

The higher VFA's concentration values of G1 and G3 groups may be due

Table (5): Live body weight changes; relative changes and body condition score during postpartum period of different experimental buffalo groups

Item	Experimental group		
	G1	G2	G3
Live body weight, (kg) at:			
Just after calving	545.13^a±9.83	504.64^b±15.62	567.57^a±13.45
$Kw^{0.75}$	112.79^a±1.53	106.34^b±2.44	116.25^a±2.07
days after calving -30	528.43^b±10.14	474.76^c±14.32	555.43^a±14.06
$Kw^{0.75}$	110.19^b±1.58^b	101.66^c±2.30	114.37^a±2.18
days after calving -120	578.03^b±1.41	501.00^c±14.75	603.07^a±13.34
$Kw^{0.75}$	117.87^b±1.41	105.84^c±2.34	121.84^a±2.03
Body weight changes, (kg) at:			
days after calving - 30	-16.69^b±2.04	-24.88^a±4.75	-12.14^c±1.22
days after calving - 120	32.90^a±3.47	-1.79^b±3.98	35.50^a±5.71
Relative changes (% unit MBS) at :			
days after calving -30	-2.31^b±0. 28	-4.43^a±0.61	-1.62^c±0.19
days after calving -120	4.52^a±0.50	-0.1^b±0.37	4.70^a±0.81
Body condition score at:			
Just after calving	2.44^b±0.29	2.20^c±0.25	2.89^a±0.28
days after calving -30	1.96^b±0.14	1.76^c±0.10	2.37^a±0.17
days after calving -120	2.69^b±0.96	1.90^c±0.09	2.79^a±0.19

a, b and c: Group means with different letters within the same row are significantly different at P< 0.05, Relative changes (% unit MBS) : $\frac{\text{Initial MBS-Final MBS x 100}}{\text{Initial MBS}}$

Table (6): Ruminal fermentation of buffalo heifers fed the different experimental groups.

Item	Experimental group		
	G 1	G 2	G 3
		zero hrs (after feeding)	
pH	6.57^b±0.12	6.73^a±0.17	6.43^c±0.14
NH_3.N mg / dl	12.64^a±0.78	10.92^b±0.70	12.70^a±0.42
VFA ml eq / dl	7.82^b±0.22	6.61^c±0.25	8.86^a±0.52
		3 hrs after feeding	
pH	6.04±011	6.49±0.12	6.01±0.02
NH_3.N mg / dl	13.80^a±0.67	12.58^b±0.51	13.47^a±0.92
VFA ml eq / dl	12.56^b±0.51	11.66^c±0.45	13.85^a±0.55
		6 hrs after feeding	
pH	5.74±0.07	6.18±0.11	5.67±0.11
NH_3.N mg / dl	11.63^a±0.68	10.52^b±0.88	11.60^a±0.66
VFA ml eq / dl	13.39^b±0.67	11.96^c±0.29	14.54^a±0.69

a , b and c: Group means with different letters within the same row are significantly different at P< 0.05.

to a higher microbial activity in the rumen of heifers fed ether 100 or 120% TDN than those recorded 80% TDN ration. Similar results were reported Punia and Sharma (1985) in buffaloes and crossbred calves. High energy supplemented diets increased the concentration of total VFA compared with the low energy intake diets, perhaps because of its NFE content.

In general the microbial activity was increased with the advance in time after morning feeding reaching the maximum activity at 3 hr after feeding then declined (Table 6). Similar trend was reported by (Bach *et al.*, (1999) and Baraghit *et al.*, 2003). This may have been due to the increase in the bacterial counts and activity.

Some reproductive traits:

Data presented in Table (7) show that animals fed high energy level (120 or 100 % TDN) recorded higher average values of buffalo body weight just before calving, calf weight, placenta weight and fetus liquid weight than those buffalo fed low energy level (80 % TDN) with high significant differences. Animal group fed (80 %TDN) recorded higher mean age at first calving and drop of fetal membrane than those buffalo fed high energy level (100 or 120 % TDN). Differences were highly significant with drop of fetal membrane. While, difference was significant with age of first calving. These results seem to agree with those of Houghton *et al.*, (1990); Bayoumi, (1995) and El-Ashry *et al.*, (2003).

Also, data in Table (7) indicated that mean interval of uterine horns symmetricity, interval from calving to the normal position of uterus and interval required to complete cervical closure were significantly shorter ($P<0.05$) in the animals fed normal or high energy level (G1 and G3). As obtained in the present study, (El-Keraby *et al.*, 1981; Hafez, 1990; Fadel, 1995 and Mahdy *et al.*, 2001) reported similar results.

Concerning, the animals fed (G3) had significant shorter in postpartum first estrus interval (PPFEI); Service period (SP) and Days open (DO) days than those (G1) ($P<0.05$) and those (G2) high significantly groups. The same trend was obtained by El-Keraby *et al.* (1981); Ezzo *et al.* (1998); Mahdy *et al.* (2001); Thatcher and Staples, (2000) and Shahin, (2000[b]). On the other hand, number of services per conception (NS/C) was significantly ($P<0.05$) higher in animals fed 80%TDN (G2) than those fed (G1and G3). However, those animals fed (G1) differ significantly ($P<0.05$) from (G3). These results were in agreement with those reported by Thatcher *et al.*, (1999); Shahin, (2000[b]) and Wafa, (2004) who found that mean number of services per conception was low for animals fed high energy level than those on low energy level.

Milk and its composition:

Results obtained in Table (8) showed that animals fed 100% TDN (G1) had significantly ($P<0.05$) higher milk yield, 7 % FCM, fat, protein, lactose, SNF, TS and Ahs yield expressed as daily, (kg) than those animals fed 120 and 80 % TDN (G3 and G2). This might be the increase in nutrients digestibility for (G1 and G3) correspond with increase live body weight and earliest ages at first calving, while, (G3) may not act complete developments of udder size, structure and recreating tissue compared with (G2). These results are in agreement with those obtained by Sharma *et al.*, (1993); Bayoumi, (1995); Ekinic and

Table (7): Some reproductive traits of buffalo heifers fed different experimental rations

Item	Experimental group		
	G 1	G 2	G 3
No. of animal	8	7	7
Buffalo weight before calving ,kg	608.38[b]±10.19	563.14[c]±13.6	632.86[a]±13.74
Calf birth weight , kg	41.63[a]±0.63	37.29[b]±1.04	41.25[a]±0.91
Calf birth weighs/ dam wt (%)	6.86±0.25	6.64±0.23	6.54±0.23
Placenta weight , kg	4.99[a]±0.08	4.45[b]±0.25	5.16[a]±0.18
Placenta weight / dam wt (%)	0.824±0.02	0.791±0.05	0.760±0.04
Drop of fetal membran (hours)	5.76[b]±0.22	8.69[a]±0.74	4.64[c]±0.13
Fetus liquid weight, kg	18.62[a]±0.47	15.90[b]±0.86	18.21[a]±0.79
Fetus liquid weight / dam w (%)	3.06±0.08	2.82± 0.14	2.89±0.15
Gestation period length , days	312.75±2.15	317.57±1.53	311.29±4.02
Age at first calving , days	881.50[b]±10.01	944.6[a]±10.96	876.57[b]±4.53
Position of the uterus , days	18.40[b]±0.81	25.20[a]±1.49	17.50[c]±0.47
Symmetrize of the uterus horns,days	26.10[b]±0.67	37.80[a]±1.61	23.29[c]±0.69
Postpartum interval to complete close of the cervix , days	26.60[b]±1.20	37.00[a]±1.22	25.40[c]±1.40
Interval to the first postpartum estrus, days	58.88[b]±6.16	72.57[a]±4.57	51.86[c]±2.64
Service period (SP), days	16.86[b]±6.02	35.14[a]±8.36	6.43[c]±6.43
Days open (DO), days	73.63[b]±8.35	107.71[a]±8.74	58.29[c]±4.64
Number of services per conception (NS/C)	1.63[b]±0.26	2.57[a]±0.37	1.29[c]±0.18

a, b and c: Group means with different letters within the same row are significantly different at $P< 0.05$

Table (8): Effect of energy level on milk yield, 7 % FCM and milk composition in buffalo milk during the first calving (first 120 days of lactation season).

Item		Experimental group		
		G1	G2	G3
Milk yield, kg / animal /d.		4.21[a]±0.26	3.95[b]±0.25	3.83[b]±0.26
7% FCM* yield, kg/animal/d.		4.25[a]±0.25	3.86[b]±0.25	3.86[b]±0.26
Milk composition				
Fat	%	6.88±0.14	6.76±0.16	7.08±0.21
Fat yield	kg	0.295[a]±0.02	0.267[b]±0.02	0.271[b]±0.02
Protein	%	4.24±0.05	4.15±0.21	4.24±0.15
Protein yield	kg	0.182[a]±0.01	0.164[b]±0.01	0.163[b]±0.01
Lactose	%	5.17±0. 09	5.10±0.08	5.26±0.13
Lactose yield	kg	0.255[a]±0.01	0.201[b]±0.01	0.201[b]±0.01
TS**	%	16.89±0.20	16.71±0.25	17.19±0.24
TS yield	kg	0.725[a]±0.04	0.659[b]±0.04	0.658[b]±0.04
SNF***	%	10.02±0.10	9.96±0.18	10.11±0.19
SNF yield	kg	0.430[a]±0.03	0.393[b]±0.03	0.387[b]±0.03
Ash	%	0.61±0.01	0.60±0.01	0.61±0.01
Ash yield	kg	0.026[a]±0.003	0.024[b]±0.002	0.023[b]±0.002

a and b: Group means with different letters within the same row are significantly different at $P< 0.05$. * 7 % FCM was calculated as 0.265x milk yield (kg) + 10.5 x fat yield (kg) (Raafat and Salch 1962), ** TS = Total solids, *** SNF = Solids not fat

Table (9): Feed conversation and economic efficiency of lactating buffaloes (First calving) fed different energy level, during the first 120 days of lactation season).

Item	Experimental group		
	G1	G2	G3
7 % FCM yield, kg/ animal /day	4.25±0.25^{a}	3.86±0.25^{b}	3.86±0.26^{b}
Daily feed intake (kg / animal /d)			
CFM	3.57	4.37	3.27
Maize	2.14	0.62	3.27
BH	3.57	4.37	2.45
RS	4.99	3.12	7.36
Total intake, (kg / animal /d)			
DM	14.26^{b}	12.48^{c}	16.35^{a}
TDN	8.58^{b}	7.26^{c}	10.19^{a}
DCP	1.10^{b}	0.88^{c}	1.25^{a}
Feed conversation :			
Kg DM / kg 7 % FCM	3.36^{b}	3.23^{c}	4.24^{a}
Kg TDN / kg 7 % FCM	2.02^{b}	1.88^{c}	2.64^{a}
Kg DCP / kg 7 % FCM	0.26^{b}	0.23^{c}	0.32^{a}
Economic efficiency :			
Average daily production, Kg			
7 % FCM yield, kg / animal /d	4.25	3.86	3.86
Gain , kg / animal /d	0.274	-0.015	0.296
Cost of feed intake (Input, LE)	8.94	7.99	10.61
Price of weight change, LE	3.56	-0.20	3.85
Price of milk , LE	8.93	8.11	8.11
Total output , LE	12.49	7.91	11.96
Return , LE	3.55	-0.08	1.35
Relative economic efficiency %	4437.50	100	1687.50

a , b and c : Group means with different letters within the same row are significantly different at P< 0.05. The price of feedstuffs and products : Feed mixture / Tom = 1100 LE; Mize / Ton = 930 LE ; BH / Ton = 750 LE ; RS / Ton = 100 LE ; Milk / kg = 2.10 LE and live body weight gain / kg = 13.00 LE.

Broderick, (1997) and El-Ashry *et al.*, (2003) who concluded that milk yield increased with increasing energy level. Results of 7 % FCM yield are in parallel with their corresponding milk yield. In this respect, El-Serafy et al., (1984), observed highest 7 % FCM yield for lactating buffaloes received 80 % NRC (1978) energy allowances compared with those received 100 or 120 %. Concerning, the percentage of milk fat, protein, lactose, TS, SNF and Ash, data in Table (9) showed no significant differences. These results agree with those reported by Metry, (1988); Sharma *et al.*, (1993); Bayoumi, (1995) and El-Ashry *et al.*, (2003) who concluded that energy level dose not affect milk composition. This might be due to the positive increase of nutrients digestibility and consequently availably for (G1 or G3) ration.

Feed conversion and economic efficiency:

The feed conversion expressed as the amount of DM, TDN or DCP intake to produce one kg 7 % FCM (Table 9) cleared that animals fed (G2) recorded highly significant ($P<0.05$) better fed conversion (kg DM, TDN and DCP / kg 7 % FCM) than those fed (G3).However, the significant differences were higher ($P<0.05$) than those of (G1) groups. These results of energy level are in agreement with those obtained by El-Serafy *et al.*,(1984); Metry, (1988) and El-Ashry *et al.*, (2003) who found that the efficiency of energy utilization for milk production was higher for animals receiving the low energy level. Improved feed conversation for animal group fed 80 % energy level (G2) of Kearl allowances, (1982) for Egyptian buffalo at first calving might be attributed mainly to degree of development the udder (size, structure and tissue) are increase and higher of age at first calving than those of (G3) groups.

Regarding the feed cost, it was indicated that animals fed on high level of energy (120 %TDN) had the most expensive values followed by those on (100%TDN). The feed cost (kg / h / d) of 120 and 100%TDN treatment formed 32.79 and 11.89 % of those fed low energy level. However, the highest values of daily 7 % FCM yield price of milk were recorded for group (G1) followed by both (G2 and G3). The high values of return over feed costs (3.55 LE) were recorded for (G1) group followed by (G3) (1.33 LE). The (G2) group was ranked the third, (-0.08 LE). Relative economic efficiency due to high energy level (G1 and G3) inclusion in the rations was 4437.50 and 1687.50 % respectively as compared to the low energy level (G2).

CONCLUSION

From the previous results, it could be concluded that pregnant buffalo heifers groups fed ration containing (100%TDN) normal energy levels showed some improvement in reproductive performance i.e., rapid growth rate and consequently a decrease the number of days on feeding till first calving. Thus, it should be recommended to apply the normal energy diets for feeding the pregnant buffalo heifer's in all stages of production and reproduction. In addition, extending the feeding period on high energy level can increase the production costs. Therefore it may be concluded that the low energy diets for feeding, animals using highly digestible roughage and consequently would increase the number of days on feeding till first calving, the buffalo heifers can economically reared .

REFERENCES

Abdel-Salam, O. (2003). Response of Ossimi lambs fed high-energy concentrates feed mixture. Al-Azhar J. Agric Res., 37: (June 2003).

Agriculture Economy Research Institute (1997). Annual Report for Agriculture Production, Ministry of Agriculture, Egypt (In Arabic).

Al-Deeb, S.L., D.G. Nissen, Morrical and J. A. Rathmacher (2003). The effect of dietary energy and protein levels on performance and nitrogen balance in heavy and normal muscle lambs. Egyptian J. Nutrition and Feeds, 6 (Special Issue): 943.

A.O.A.C. (1995). Official Methods of Analysis. 15th ed. Association of Official Analytical Chemists Washington, Virginiall U.S.A.

Bach , A. ; I.K. Yoon ; M.D. Stern ; H.G. Jung and J.H . Chester (1999). Effects of type of carbohydrate supplementation to lush pasture on microbial fermentation in continuous culture. J. Anim. Sci., 82: 153.

Baraghit , G.A. ; N.M. El-Kholy; S.S. Omar; B.M. Ahmed and Kh. I. Zedan (2003) . Effect of dietary fat source on digestibility rumen fermentation and blood parameters of buffalo calves. Egyptian J. Nutrition and Feeds, 6 (Special Issue): 663.

Bayoumi , H.M. (1995). Productive and reproductive performance of Egyptian buffaloes as affected by feeding level during mid–pregnancy and early stage of lactation. M.Sc. Thesis, Fac.of Agric., Moshtohor, Zagazig Univ. Banha Branch , Egypt.

Bergfeld , E.G.M. ; F.N. Kojima ; A.S. Cupp ; M.E. Wehrman ; K.E. Peters ; M. Garcia-Winder and J.E. Kinder (1994). Ovarian follicular development of prepubertal heifers is influenced by level of dietary energy intake. Biology of Reproduction, 51 : 1051.

Borhami , B.E.A. and M.H.M. Yacout (2001). Is the animal protein essential for better utilization of plant protein in ruminants ? Egyptian J . Nutr . and Feeds, 4 (Special Issue).

Chauhan, T.R. and A.K. Chopra (1986). Cowpes (*Vignasinensis*) hay as a replacement for conventional concentrate mixture in the ration of buffalo calves. Indian J. Animal Sci., 56: 558.

Dawson, K.A.(1994). Current and future role of yeast culture in animal production . A review of research over the last six years. Proc. Alltech's 8th Ann. Symp. (Suppl), Alltech , Tech. Publ., Kentucky USA, P1.

Duncan, D.B. (1955). Multiple rang and mutiple – Test . Biometric , 11 : 1 .

Dunn, T.G.; J.E.Ingalls; D.R. Limmerman and J.N. Wiltbank (1969). Reproductive performance of 2- year-old Hereford and Angus heifers as influenced by per-and post calving energy intake. J. Anim. Sci., 29: 719.

Ebrahim, S.A. (2004). Physio-nutritional studies on Egyptian buffaloes. Ph. D. Thesis , Fac. of Agric. Mansourah Univ., Mansoura, Egypt.

Ekinci, C. and G.A. Broderick (1997). Effect of processing high moisture corn on ruminal fermentation and milk yield J. Dairy Sci., 80 : 3298.

El–Ashry, M.A. ; H.M. Khattab; K.E.I. Etman and S.K. Sayed (2003). Effect of two different energy and protein levels on productive and reproductive performances of lactating buffaloes. Egyptian J. Nutrition and Feeds, 6 (Special Issue) : 491.

El-Badawi, A.Y. ; M.H.M. Yacout ; H.E.M. Kamel ; A.A. Abdel-Aziz and G.H.A. Ghanem (2001). Nutritional evaluation of concentrate mixtures containing sugar beet pulp in diets of dairy cattle. Egyptian J. Nutrition and Feeds, 4 (Special Issue) : 511.

El-Keraby, F.E ; M.B. Aboul-Eta and L.H. Bedeir (1981). The effect of dietary on postpartum reproductive traits in buffaloes. Agric. Res. Rev., 59 : 1-13.

El-Serafy, A.M. ; H.M. Khattab ; M.A. El-Ashry ; H.S. Soliman ; S.M. Allam ; H.M. Aly and H. Gado (1984). NRC-energy allowance for milking buffaloes: Effect on lactation performance. Milk composition and some blood traits. Egypt J. Anim. Prod., 24 : 127.

Etman, K.I. (1985). The effect of limit of concentrate feeding and roughage on meat production . Ph. D. Thesis , Fac. of Agric. Moshtoher, Zagazig Univ.

Ezzo, O.H.; A.A. Hoda; K.E. El-Ekhnawy; H.M. Youssef (1998). Implication of pre-and postpartum energy intake with body condition to direct reproductive performance of Friesan dairy cow. Alex. J. Vet. Sci., 14: 97-113.

Fadel, M.S. (1995). The postpartum period in cows and buffaloes. M. Vet. Sci. (Theriogenology) Thesis, Fac. Vet. Med., Cairo Univ., Egypt .

Gordon, F.J. and J.J. Forbes (1970). The associative effect of level of energy and protein intake in the dairy cow. J. Dairy Res., 37: 481.

Hafez, E.S.E. (1990). Reproductive behavior. In reproduction in farm animals. 5th Ed. LEA and FEBIGER, Philadelphia., USA.

Hancock , KL; JR. Kropp; K.S. Lusby; R.P. Wettemann; D.S. Buchanan and C. Worthington (1985). The influence of postpartum nutrition and weaning age of calves on cow body condition, estrus, conception rate and calf performance of fall-calving beef cows. Animal Science Research Report, Agricultural Experiment Station, Oklahoma State University, MP-117, 180.

Helmy, G.H. (1988). Studies on productive and reproductive traits of Egyptian buffalo as affected by steaming up and feeding in early stage of lactation . Ph. D. Thesis , Fac. of Agric., Zagazig Univ., Moshtohor, Banha Branch , Egypt .

Houghton, PL.; R.P. Lemenager ; L.A. Horstman; K.S. Hendrix and G.E. Moss (1990). Effects of body composition , pre-and postpartum energy level and early weaning on reproductive performance of beef cows and preweaning calf gain. J. Anim. Sci., 68 : 1438.

Jordanovski. N. (1993). Effect of dietary energy level on growth performance of early weaned lambs fattened to 84 days old. Krmiva . 35 : 173 –178 .

Kearl, L.C. (1982). Nutrient allowance of ruminants in developing countries. International Feedstuffs Institute Utah Agricultural Experiment Station Utah State University , Logan Utah December.

Khathar, M.S.; A.K. Jain and O.S. Parmar (1992). Body weight changes after calving and their ration ship with milk yield and service period in crossbred cows. J. Anim. Breed. Genet., 105: 300-305.

Kishan, J.; N. Kewalramani ; B.N. Gupta and S.P. Arora (1985) . Influence of levels of energy on CO_2 production rate, TVFA concentration in the rumen and nutrients digestibility in buffaloes. Indian J. Anim. Sci., 55: 620.

Mahdy, A.E.; O.M. El-Shafie and H.A. El-Rigalaty (2001). Relative importance of some factors affecting performance traits in a herd of Egyptian buffaloes .Alx. J. Agric. Res. , 46 :1-18.

Manninen, M. and H. Huhta (2001). Influence of pre- and postpartum plane of nutrition on the performance of crossbred suckler cows and their progeny. Agricultural and Food Science in Finland , 10 : 1 , 3.

Marston, T.T. ; K.S. Lusby and R.P. Wettemann (1992). Pre-and post-calving protein or energy supplementation of spring-calving beef cows. Animal-Sci. Research Report, Agricultural Experiment Station Oklahoma State University. NO. MP-136, 179.

Metry, G.H. (1988). Studies on productive and reproductive traits of Egyptian buffalo as affected by steaming up and feeding in early stage of lactation . Ph. D. Thesis, Fac. Agric., Moshtohor , Zagazig Univ., Egypt .

Metry, G.H.; J.C. Wilk; R.E. McDowell and H.A. El-Rigalaty (1994). Factors affecting the performance of Egyptian buffaloes. Anim. Agric. Sci., Moshtohor, 32 : 755.

Mostageer, A.; M.A. Morsy and R.R. Sadek (1993). The production characteristics of a herd of Egyptian buffaloes. Z. Tierz. Zurcht. Biol., 98: 220.

Muinga, R.W.; W. Thorp and J.H. Topps (1993). Lactational performance of Jersey cows given Napiers fooder (*Pennisetum purpureum*) with and without protein concentrates in the semilunid tropics . Tropical Animals Health and Production , 5 : 118.

Punia, H.S. and D.D. Sharma (1985). Influence of dietary energy source on rumen fermentation in buffaloes and cattle . Asian J. Dairy Research, 4 : 39.

SAS Institute, Inc. (1995). SASI STAT Guide for personal computers, Vers I

Shahin, G.F. (2004a). Effect of dietary energy level on:1- Digestibility and performance of growing buffalo heifers. Egyptian J. Nutrtion and Feeds 7 (1): 43.

Shahin, G.F. (2004b). Effect of dietary energy level on nutrient utilization, productive and reproductive performances of growing buffalo heifers. Egyptian J. Nutrition and Feeds 7 (2): 143.

Shahin, G.F. (2000). Effect of dietary energy level and protein source on sheep performance. Ph. D. Thesis, Fac . Agric. Menoufiya Univ .

Sharma, A.K.; O.R. Takkar and K.C. Chaudhary (1993). Plasma production and milk production in Murrah (*Bos bubalis*) buffaloes fed with elevated energy levels during pre and postpartum period . Indian J. Anim. Reprod., 14 : 1.

Thatcher, W.W. and C.R. Staples (2000). Effect of dietary fat supplementation on reproductive in lactating dairy cows . Page 213 in Adv. In Dairy Tech., Vol. 12 Alberta Univ., Depart, Agric., Food and Nutr.

Thatcher, W.W. ; C.R. Staples; H.H. Van and C.A. Risco (1999). Reproductive and energy status interaction ships that influence reproductive nutritional management of the postpartum lactating diary cows. Page 25 in the Proceeding of the 14th Annul Southwest Nutrition and Management Conference, February 25, Arizona, USA.

Tiwari, S.P. ; Sanjeev Kumar and H.P. Narang (1990). The effect of protein and energy levels during late pregnancy on nutrient utilization and kid birth weight in goats. Acta Veterinaria, Beograd , 40 : 297.

Vandehaar, M.J. ; G. Yousif; A.B.K. Sharma; T.H. Herdt; R.S. Emery; M.S. Allen and J.S. Liesman (1999). Effect of energy and protein density of prepartum diets on fat and protein metabolism of dairy cattle in the preparturient period. J. Dairy Sci., 82 : 1282.

Van-Keulen, J. and B.A. Young (1977). Evaluation of acid-insoluble ash as anatural marker in ruminant digestibility studies. J. Anim. Sci., 44 : 282.

Wafa, W.M.F.A. (2004). Improving the fertility in Friesian cattle. M. Sc. Thesis, Fac. Agric., Al-Azhar Univ., Cairo, Egypt.

Zaki, A.A. and G.F. Shahin (2004). Effect of feeding on digestibility, nutritive values, productive performance of lactating buffaloes. J. Agric. Sci, Mansoura Univ., 29: 3021.

Zedan, K.I. (1995). Effect of dietary energy on the performance of milking buffaloes. M. Sc. Thesis, Fac. Agric. Menoufiya Univ., Shebin El-Kom, Egypt.

أثر مستوى طاقة الغذاء على معاملات الهضم وتخمرات الكرش والأداء الإنتاجي والتناسلي لعجلات الجاموس الحوامل

جمال فاروق شاهين ــ عبد العليم ذكي- حمدي المطراوى دياب

معهد بحوث الإنتاج الحيواني - مركز البحوث الزراعية ــ الدقي الجيزة

تهدف هذه الدراسة معرفة تأثير استخدام ثلاث مستويات من الطاقة في علائق عجلات الجاموس تبعا لمقرارت كيرل ١٩٨٢ (٨٠ - ١٠٠ ــ ١٢٠ % من مجموع المركبات الغذائية المهضومة) على معاملات الهضم وتخمرات الكرش ومعدل الأداء الإنتاجي والتناسلي. استخدم في هذه الدراسة عدد ٢٢ من عجلات الجاموس النامية متوسط العمر والوزن هو ٦٥٨,٧٥ ــ ٧١٥,١٣ ــ ٦٥٣,١٣ يوم و ٤٥٠,٨٨- ٤٢٨,٤٣ ــ ٤٦٧,٢٥ كجم وذلك للمجاميع المغذاه على علائق تحتوى (١٠٠و ٨٠ و ١٢٠ % من المركبات الغذائية المهضومة).

المعاملة الأولى وفيها تناولت الحيوانات غذاء يحتوى على ١٠٠% من احتياجاتها من المركبات الغذائية المهضومة والمعاملة الثانية تناولت الحيوانات غذاء يحتوى على ٨٠ % من احتياجاتها من المركبات الغذائية المهضومة والمعاملة الثالثة حيث تناولت الحيوانات غذاء يحتوى على ١٢٠% من احتياجاتها من المركبات الغذائية المهضومة وقد أحتوت جميع المعاملات على ١٠٠% من الأحتياجات من البروتينة و أستمرت التجربة حوالي ٢٢٨ يوم تم خلالها دراسة أداء العجلات حيث يتم وزن الحيوانات كل ١٥ يوم و أخذ عينات من الغذاء المأكول ومن روث لكل حيوان لمدة ثلاثة أيام متتالية حيث استخدم لتقدير معاملات هضم المركبات الغذائية المختلفة باستخدام الرماد غير الذائب كمرقم داخلي.

وكانت أهم النتائج :

- المجاميع التي غذيت على مستوى عالي من الطاقة أظهرت اتجاه لزيادة معامل الهضم كل المركبات الغانية وأن هذه الزيادة كانت معنوية في حالة هضم المادة الجافة والعضوية والمستخلص الأثيري و الهضم البروتين الخام والمستخلص الخالي من الأزوت و وكذلك القيمة الغذائية ومن ناحية أخرى انخفض معامل هضم الألياف في المجموعة العجلات التي غذيت على مستوى عالي من الطاقة بالمقارنة بالمجموعة التي غذيت على مستوى منخفض من الطاقة .
- أظهرت المجاميع التي غذيت على مستوى ١٠٠ أو١٢٠% من المركبات الغذائية المهضومة زيادة في معدل الزيادة فى الوزن وعدل التغير في الوزن ووزن كل من المشيمة والسوائل الجنينية ووزن العجل عند الميلاد وتحسنت أيضا الكفاءة التحويلية للغذاء على أساس (كجم مأكول من المادة الجافة والبروتين المهضوم اللازم لإنتاج كجم زيادة في الوزن) وذلك بالمقارنة بالمجموعة التي غذيت على مستوى ٨٠% من المركبات الغذائية المهضومة في حين تحسنت الكفاءة الغذائية على أساس (كجم مأكول من المركبات الغذائية المهضومة اللازم لإنتاج كجم زيادة في الوزن) وكذلك ذادت الفترة اللازمة لنزول المشيمة وذلك في الحيوانات التي تتغذى على مستوى منخفض من الطاقة (٨٠%) بالمقارنة بالمجموعة التي غذيت على مستوى ١٠٠ أو١٢٠% من الطاقة (المركبات الغذائية المهضومة) وكانت الاختلافات معنوية .
- أسفرت الدراسة أن هناك اختلافات معنوية في الفترة من الولادة حتى أول شياع ومن أول شياع حتى حدوث الحمل ومن الولادة حتى حدوث الحمل كانت تلك الفترة اقل في المجموعة التي غذيت على مستوى عالي من الطاقة بالمقارنة بمستوى المنخفض من الطاقة وكذلك وجد أن عدد التلقيحات اللازمة للإخصاب اقل في المستوى العالي.
- أظهرت العليقة التي تحتوى على مستوى طاقة ١٠٠% أعلى لمحصول اللبن واللبن المعدل للنسبة الدهن ٧% وكذلك أعلى معدل لمحصول كل من الدهن والبروتين واللاكتوز والجوامد الكلية والجوامد ألا دهنية والرماد الخام اليومي وكانت تلك الزيادة معنوية عند مستوى ٥% بالمقارنة بالعليقة التي تحتوى على ١٢٠ أو ١٠٠% طاقة.
- لم تتأثر قيم pH سوائل الكرش نتيجة المعاملة الغذائية بينما ارتفعت تركيزات الأمونيا والأحماض الدهنية الطيارة بكرش العجلات المغذاة على علائق تحتوى على مستوى طاقة ١٠٠ أو ١٢٠% طاقة بالمقارنة بالمستوى المنخفض من الطاقة ٨٠% .

- مما سبق يتضح أن تغذية العجلات على مستوي ١٠٠% طاقة حسنت معدل النمو اليومي والكفاءة الغذائية والاقتصادية وذادت من تركيز جلوبينات المناعة في لبن السرسوب وقلت الفترة حتى أول ولادة .

- المجموعة التي غذيت على مستوى الطاقة المنخفض ٨٠% أظهرت تحسن في الكفاءة التحويل الغذائي لكل من المادة الجافة والمركبات الغذائية المهضومة والبروتين المهضوم تليها مجموعة التي غذيت على مستوى ١٠٠% ثم ١٢٠% طاقة ولكن بالنسبة للكفاءة الاقتصادية وجد أن الحيوانات التي غذيت على ١٠٠% طاقة كانت أعلى ثم يليها ١٢٠% ثم ٨٠% طاقة والفروق معنوية جدا.

- ولذلك يمكن التوصية بالتغذية على مستوى طاقة ١٠٠% من مقررات كيرل (١٩٨٢) حيث أعطت افضل نتائج لكل من الهضم و الكفاءة الغذائية و معدلات نمو و إنتاج اللبن والأداء الإنتاجي والتناسلي و أفضل مردود اقتصادي لعجلات الجاموس النامية.