14 *Egypt. J. Anim. Prod.* **24**, No. 1-2 pp. 127-136 (1984)

NRC-Energy Allowances for Milking Buffaloes. Effect on Lactation Performance. Milk Composition and some Blood Traits

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TWENTY four lactating buffaloes in their first season were divided, into three groups of eight animals each. They were given three dietary levels of energy which represented 100 (group 1), 120 (group 11) and 80 % (group 111) of the productive energy allowances were recommended . Protein allowances were held constant in the three experimental diets.. These allowances were given after a week post-calving and the experiment lasted throughout the first lactation season (300 days) and the first eight weeks of the second lactation season.

The results showed no significant differences (P>0.05) between treatments with regard milk yield and 7 % FCM yield. Highest FCM yield was recorded in the third group (80 % energy level). Milk fat, protein and solids not fat percentages were not affected significantly (P>0.05) by the level of dietary energy. Blood serum VFA concentration, protein nitrogen, non-protein nitrogen and urea all determined at 2, 4, 7 and 12 months post-calving were not affected by treatment. Gross or net efficiency of ME utilization for milk production was highest in the group of animals receiving the 80 % energy level. It was concluded that 80 % of NRC energy allowances above maintenance is adequate for milk production in lactating water buffaloes.

There is a general agreement that an increase in energy intake of the dairy cows within certain limits, increases milk yield, SNF and to a lesser extent lactose and decreases milk fat (Gordon and Forbes, 1970). Extra increase in energy intake may result in body weight increase on the expense of milk yield particularly in low producing animals (Mcdonald, Edwards and Gneerholgh, 1973).

The literature was reviewed with regard to nutritional factors affecting milk production from cattle and buffaloes. It was concluded that although extensive work has been carried out with lactating cows, little is known (Khattab, 1967) about the response of lactating water buffaloes to nutritional factors affecting milk production.

The present work has been, therefore carried out to determine the proper level of energy needed for milk production in lactating water buffaloes, when protein intake was held constant.

Material and Methods

The experiment started with 24 pregnant (7-8 months) water buffalo heifers. Animals were randomly divided on three groups of eight each. They were given three experimental diets formulated to supply three levels of energy namely 100 % (group 1), 120 % (group 11) and 80 % (group 111) of the energy allowances recommended by the NRC (18) for the last eight weeks of pregnancy. A week after parturition, the respective groups were given NRC allowances for milk production calculated for one kg of milk containing 7 % fat (average of a standared water buffalo). Dietary protein allowances were held constant in the three experimental diets (100% of NRC requirements).

Rations consisted of a concentrate mixture (undecorticated cotton seed cake 50 %, rice bran 8 %, wheat bran 12 % corn 25 % cane molasses 4 % and 1 % mineral salts). Rice straw and Berseem hay (prepared from *Trifolium alexandrinum*) were used as roughage sources and represented 50 % of the ration dry matter. The rations were adjusted according to milk production to the different levels of energy allowances by the addition of corn maize and cane molasses. Table 1, shows the composition of the experimental rations on dry matter basis. Animals were individually fed in a concrete made pen in a face-to face position. The concentrate and Berseem hay were weighed separately for each animal and offered at milking times (06·00 am and 16·00pm). Milking was performed manually. Weighed rice straw was available in pens all time. The concentrates and roughages were adjusted weekly according to the changes in milk yield and live weight.

Milk yield was recorded daily during the first lactation season (300 days) and during the first 8 weeks (peak lactation) of the second season. Milk composition was determined for each animal using a 24-hr composite sample collected every week to determine fat content (Gerber method), total solids (A.O.A.C. Method, 1975) and total nitrogen (Micro Kjeldahl method). Blood samples were taken from each animal from the jugular vein at 2,4,6 and 8 hr after the morning feed four times throughout the experimental period : after 2.4.7. and 12 months of calving. Blood serum samples were analyzed for protein nitrogen, non-protein nitrogen, urea and VFA's (GLC). The results obtained from the experiment were subjected to analysis of variance one-way classification according to Snedecor and (Cochran 1967).

Results and Discussion

The production performance data and analysis of milk during the 1*st* lactation season and the first 8 weeks of the 2*nd* lactation season are given in Table 2. No significant differences ($P > 0.05$) were found among, treatments with regard milk or 7 % FCM yield. Highest value for FCM was that of treatment 111 (80 % of NRC-energy allowances). It seems probable that milk yield in this experiment was affected directly by the energy : protein ratio in the ration, since the protein requirement above maintenance was held constant. The energy : protein ratios of the three rations were 5·1, 5·6 and 4·9 for treatments 1, 11, and 111, respectively. This finding agrees well with that reported by many investigators, Spahr *et al.*, Gordon *et al* Mcdonald *et al* ., Broster *et al.*, Singh *et al*

TABLE 1. Constituents of the experimental rations (on dry matter basis).

Item	Energy levels		
	I (100%)	II (120%)	III (80%)
	%	%	%
Concentrate mixture	27.9	26.1	25.5
Berseem hay	17.9	16.1	18.5
Rice straw	32.9	28.7	34.4
Wheat bran	3.6	3.3	3.7
Corn maize	10.7	12.9	11.2
Cane molasses	7.0	12.9	6.7
TDN	48.5	49.9	48.1
DP	7.2	6.9	6.9

Results of milk fat content (Table 2) indicated that as milk yield increased, fat percentage was insignificantly ($P > 0\ 05$) decreased. Similar negative co-rrelation between milk yield and fat percentage was reported) Yanava, 1967; Kurawsk , 1968 and Mokhtar, 1971). The insignificant effect of the different energy levels on milk fat percentages was attibruted to the nearly similar roughage : concentrate of the three rations (Kurawski, 1968). Thus, the increase in energy level was not associated with changes in the ratios of roughage : concentrates which may have had an effect on the relative proportions of the VFA's in the rumen (Armstrong 1968).

Inspection of the data concerning milk protein and SNF percentages (Table 2), showed a similarity between figures of the three treatments during the two lactation season (P>0·05). These results agree well with those reported by many researches (Thomas, Brown and Emery, 1970; Lofgren and warner, 1970 ; Mertens, Conbeu, Martz and Hildesberand 1971, Paquay, Baere and lausse, 1972, Marshal and Van Horn 1975, Brown, Turner, Dahell, Whiting and Schuh 1975).

TABLE 2. **Average milk yield, FCM and milk composition of lactating water buffalo fed rations with different energy levels during two lactation seasons.**

Item	Energy levels[a]					
	I(100)		II(120)		III(80)	
	First[b]	Second[c]	First	Second	First	Second
Milk yield kg/day	6.8	9.8	5.7	9.4	6.6	10.0
FCM[d] yield kg/day	6.9	10.2	6.1	10.0	7.0	10.6
Fat, %	7.6	7.8	8.6	8.7	8.1	8.2
Protein, %	4.4	3.5	4.6	3.4	4.6	3.3
SNF, %	9.7	7.2	10.5	7.6	9.9	7.1

a) The energy levels (100, 120 and 80%) of NRC (1978) allowances.

b) First lactation season.

c) Second lactation season (the first 60 days).

d) Corrected to a standard 7% fat.

It was shown that blood urea is a better and easier indicative to the extent of dietary protein utilization in ruminants (Abau Akkada and Osman,1967). Perkins (1960) reported that as the level of dietary crude protein increased, blood urea and NPN increased. Values for protein, non-protein nitrogen and urea of the blood in the first lactation season are presented in Table 3. No significant (P<0·05) differences have been detected between treatments with regard to these traits. These results were expected since dietary protein of the three treatments was equal.

TABLE 3. Blood serum protein-nitrogen (PN), non-protein nitrogen (NPN) and urea of lactating water buffalo fed rations with different energy levels.

Item	Months from calving	Energy levels			
		I(100%)	II(120%)	III(80%)	Average
PN, g/100 ml. . .	2	1.13	1.13	1.14	1.13
	4	1.14	1.13	1.14	1.14
	7	1.13	1.13	1.13	1.13
	12	1.13	1.13	1.13	1.13
NPN, mg/100 ml. .	2	43	43	43	43
	4	43	43.5	42.8	43.1
	7	43	43.3	43	43.1
	12	43.5	43.5	42.8	43.3
Urea, mg/100 ml. .	2	33.8	33.8	34	33.8
	4	34	34.8	33.8	34.2
	7	33.8	33.8	34	33.8
	12	34.3	34	33.8	34

Mean values of serum acetic (C_2), propionic (C_3) and butyric (C_4), acids expressed on molar percentages basis and determined at different stages of lactations for animals given different energy levels are presented in Table 4. The results showed some variatious in VFA's distribution. During the first and third periods of the first lactation season : C_2 was the predominant acid followed by C_4 and C_3 acids. However, C_4 appeared to be the predominant acid followed by C_3 and C_2 during the second and fourth periods of the lactation season. As no change occurred in the composition of the three experimental diets throughout the expriment, then it is possible to assume that such variations may have been due to the interconvertion between the three VFA's particularlay between C_2 and C_4 acids (Armstrong, 1968) and to differences in rates of removal of the VFA's from the blood. The data obtained in the first and third periods of the first lactation season appeared to be closer to the pattern of rumen fermentation of carbohydrates for animals given the same rations used in the present experiment (Mcdonald, Edwards and Greenholgh 1973).

TABLE 4. **Molar percentage of acetic, propionic and butyric acids in blood serum o lactating water buffalo fed rations with different energy levels.**

Time from calving	Energy levels								
	I(100%)			II(120%)			III(80%)		
	C_2	C_3	C_4	C_2	C_3	C_4	C_2	C_3	C_4
2 months	40.77	26.49	32.91	39.20	25.31	35.50	37.64	31.18	26.18
4 months	24.72	17.81	57.47	27.33	24.57	48.10	25.73	21.15	53.13
7 months	52.56	17.46	29.99	36.84	28.95	34.21	50.52	18.30	31.18
12 months	21.99	20.65	57.36	23.89	33.89	53.92	52.17	13.66	34.17

Attempt was therefore, made to calculate the non-glucogenic to glucogenic ratio (NGR) proposed by Orskov (1975) from the data obtained in the first and third period or the lactation season. Several calculations made by Orscov (1975) showed that only when the NGR is above 4·0 will the utilization of ME begin to decrease. The present results revealed that the NGR was 4.98, 3..97 and 4·1 for groups given 100, 120 and 80% energy levels, respectivily. So, the concept of orskov doesn't agree with the present results co cerning the NGR of the blood serum VFA's.

Gross efficiency of ME utilization for milk production was highest for animals receiving the 80 and 100% energy levels. Net efficiency, however, was highest for those given the 80% level (Table 5). Animals given the 80, 100 and 120% levels gained 37·0, 47·0, and 54·0 kg, respectively in terms of live weight during the first lactation season. Blaxter (1960) Armstrong (1968) and Mayanard (1969) stated that as the plane of energy intake rises, the yield of milk increase although or an even diminishing rate and the decline in rate of increase is associated with increasing live weight gain. Thus, if it is assumed that 80% of the body weight increase was in the form of body fat with gross energy content of 9·3 Kcal/c. then it is possible to partion with some precesion, the distribution of ME between milk and body tissues. Such claculation (Table 5) raised the net efficiency of ME utilization for milk production in the three groups. It also showed that 6.5, 7.0 and 10·0% of the ME/kg 0·75 available above maintenance has been directed towards body fat synthesis, for animals given 80, 100 and 120% energy levels, respectively.

TABLE 5. Gross and net efficiencies for energy utilization during the first lactation season

Item	Energy levels		
	I (100%)	II (120%)	III (80%)
No. of Animals	8	8	8
Mean weight, kg	472	493	489
Mean metabolic body size MBS (kg),	101.3	104.6	104
DM intake/animal/day, kg,	13.2	14.5	13.2
ME energy intake/day, Mcal,	25.4	28.6	25.5
ME intake/MBS, Kcal (A),	251.1	273.3	245
ME for maint./MBS, Kcal,	90.6	146.6	113.1
ME above maint./MBS, Kcal (B),	160.5	126.7	131.9
Milk produced/animal/day kg,,	6.8	5.7	6.6
Fat produced/animal/day, kg,	0.52	0.49	0.53
Protein produced/animal day, kg,,	0.30	0.26	0.28
Total energy of milk, Kcal,	8316.73	7813.26	8288.80
Total energy of milk/MBS, Kcal, (C),	82.1	74.7	79.7
Energy of fat/MBS, Kcal(D), Energy of protein/MBS,	47.2	43.1	46.9
Kcal, (E)	16.6	13.9	15.1
D : C%	57.5	57.7	58.9
E : C%	20.2	18.6	18.9
Gross milk efficiency of milk energy (utilization) C/A,/%	32.7	27.3	32.5
Net efficiency of milk energy (utilization C/B,%	51.2	59.0	60.4

TABLE 6. **Comparisons between previously reported and presently suggested allowances of energy and protein for lactating cattle and a standard* water buffalo.**

Item	NRC 1978	Ghoneim 1955	Shehata 1977	Tommi 1963	Proposed** (present) allowances
TDN					
maint., kg.,	3.43	2.7	3.1	3.5	3.43
Above maint.kg.,	3.36	2.8	2.97	2.6	2.69
Total,	6.79	5.5	6.07	6.1	6.03
DP					
Maint.,kg.,	301	250	305	320	301
Above maint.,	484	602	700	700	484
NP*** to DP					
factor,	1.53	1.9	2.2	2.2	1.53
Total, g,	785	852	1005	1020	785

* Standard lactating water buffalo is that weighing 500 kg and producing 7 kg milk that contains 7% fat.

**80% of the NRC (1978) energy allowances above maintenance.

*** Factors used to convert net protein (NP) of milk to digestible protein (DP), were calculated on the basis of 7 kg milk production with 4.5% protein in milk.

A comqarison was made between the present tested allowances (NRC,1978) and those of Ghoneim (1955), Shehata (1977) and Tommi (1963) as shown in Table 6. Considering the 80% level of energy used in this experiment is adequate for a standard buffaloe (500 kg live weight and producing 7.0 kg of 7% FCM/day) then the suggested allowances will arrive to a value of 6.03 kg TDN/day. Such level was found to be very similar to that of Shehata (1977) and Tommi (1963) as shown in Table 6. It was however 11% higher than that of Ghoneim (1955). Protein level used in the present study was 100 % of the NRC allowances for milk production. Such level is believed to be adequate for lactating buffaloes according to Ghoneim (1955). It was however, 22 to 23% lower than that of Shehata (1977) and Tommi (1963). These differences were mainly due to variations in the factors used to convert net protein (NP) of milk to digestible protein (DP). Tommi (1963) and Shehata (1977) used a factor of 2.2 (NP × 2.2 = DP), while the NRC (1978) used the factor of 1.53.

It is possible therefore to conclude that 80% of NRC energy allowances for milk production can meet the requirements of a lactating water buffalo producing on the average 7 kg of milk containing 7% fat per day.

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تأثير الطاقة المسموح بها على انتاج اللبن وتركيب اللبن والدم في الجاموس الحلاب

عبد الفتاح الصيرفي ، حمدي خطاب ، محمد عبد المنعم العشري ، حسين سليمان،
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كليتي الزراعة ، جامعة عين شمس وجامعة القاهرة والمركز القومي للبحوث

وجد أن الطاقة المسموح بها تؤثر تأثيرا كبيرا على تركيب كل من اللبن والدم مع زيادة الادرار في اللبن على توازن الطاقة من البروتين المهضوم