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NE_m and NE_g Values of Rations Containing Different Roughage to Concentrate Ratio

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THE comparative slaughter technique was used with 30 growing sheep to determine net energy requirements for maintenance (NE_m)and gain(NE_g)and the NE values of three rations containing different roughage : concentrate ratio on SE basis namely : 50 : 50 (ration I), 40 : 60 (ration II) and 30 : 70 (ration III). The metabolizable energy concentration of the 3 diets were 2.034, 2.170 and 2.273 Kcal/gDM for rations I, II and III, respectively. The NE_m and NE_g of the rations were 1.648, 1.758 and 1.842 and 1.393, 1.483 and 1.390 Kcal/ gDM for treatments I, II and III, in respective order. The efficiency of ME conversion to maintenance was equal in the three treatments (81 %) although NE_m values were unequal. The daily NE_g requirements of sheep were 2.788, 4.324 and 4.943 Kcal/kg gain/$w^{0.75}$ for the sheep fed rations I, II and III, respectively.

High levels of concentrates are usually included in rations for lambs when they are prepared for marketing or when raised under intensive systems of pro duction, or in instances where the prices of roughages exceed those of conce-entrates. At present, ın Egypt, rations based on high levels of roughages are relatively expensive than those based on high concentrates on equal energy content basis.

Several methods are frequently used to determine the nutritive value of feedstuffs. These methods include : chemical analysis, Invitro and Vivo measurements of digestibility and animal performance data. However, the concept of determining net energy values of diet by the California Net Energy System (Lofgreen and Garrett, 1968) offeres a new approach to the evaluation of the net energy values of a feed.

Therefore, the object of this experiment was to determine the NE_m and NE_g values of 3 types of rations for sheep when fed during a growth-finishing period of 112 days.

Material and Methods

Animals and their managements, and feeding

Thirty Merino-Rahmani sheep of about 11 months age were used in these experiments. An initial slaughter group of 5 animals were killed at the start of the trial. The remaining 25 animals were alloted into three groups at random to consume one of the following rations containing roughage : concentrate ratios of 50 : 50, 40 : 60 and 30 : 70 on starch equivalent basis (treatments I, II & III, respectively). The experimental period was extended for 112 days.

Sheep were kept indoor in brick-made pens, fed once a day. Feed orts, if any, was removed and weighed and shrunk live body weight changes were weekly recorded.

The rations consisted of Berseem hay (Trifolium Alexandrinum) and wheat straw as the sources of roughages and of a concentrate mixture which composed of : 50 % undecorticated cotton-seed cake, 25 % corn, 12 % wheat bran, 8 % rice bran, 4 % molasses, and 1 % salt and minerals.

Digestibility trials were conducted concurrently with the main experiment, and the ME of the ration was calculated by multiplying digestible energy (DE) by the factor of 0.82 (N.R.C., 1969).

Determination of energy retention and NE values

Energy retention was estimated from the difference in energy content between the final and the initial slaughter animals. Energy content of the body was based on experimentally determined values for protein and fat of 5.570 and 9.354 Kcal/g dry matter respectively, as reported by Garrett *et al.* (1959).

The net energy requirement for maintenance (fasting heat production) value used was that reported in Rottray *et al* (1973c ; 79.4 Kcal/$W^{0.75}$/day) and the metabolizable energy requirement for maintenance (98 Kcal/$W^{0.75}$/da) reported in the NRC publication (1975).

The net energy content of the diet for maintenance (NE_m), was calculated from the ratio of FHP/$W^{0.75}$ kg to DM intake/$W^{0.75}$ kg required for maintenance. Net energy content of the diet for gain (NE_g), was derived from the regression of daily energy gain (Kcal/$W^{0.75}$) on daily DM, g intake/$W^{0.75}$. Details of procedure and calculations are found in publications by El-Serafy *et al.* (1974) and Soliman *et al.* (1980).

Chemical analysis of feedstuffs, faeces and carcass samples were done according to the AOAC procedures (1970).

Results and Discussion

Initial and final empty body weights (EBW), their energy content and daily energy gains are presented in Table 1. The results showed that increasing the proportion of concentrate increased values of final EBW and their fat and protein contents and consequently the energy gained increaeed with the increase in the level of concentrates in rations (values were 637, 1048 and 1134 Kcal/da in treatments I, II and III, respectively ; it was calculated that energy deposited in bodies increased by 80 % and 90 % as a result of the increase in the level of concentrates in rations from 50 to 70 %. Similar conclusion was reported by Rattray *et al* (1973a, 1973b).

TABLE 1. The Determination of Energy Gained (112 days).

Item	Treatments (rations)			
	I	II	III	Avg.
Intakes of sheep, Mcal/da				
GE	4.565	5.758	6.142	5.488
DE	2.739	3.628	3.992	3.453
ME (ME concentration of rations)	2.034	2.170	2.273	2.159
ADG ,g/da	100	105	93	99
Initial EBW ,kg	19.143	22.495	22.495	21.378
DM in initial EBW,%	28.31	29.79	29.79	29.297
Energy content of initial EBW ,Mcal	27.710	34.757	34.757	32.408
Final EBW ,kg	44.713	49.640	48.190	47.514
Composition of final EBW,%				
DM	35.40	44.82	46.53	42.25
Fat	36.37	51.06	54.19	47.21
Protein	51.23	37.03	38.54	42.27
Energy of fat(1) ,Mcal	53.849	106.263	113.660	91.26
Energy of protein(2), Mcal	45.166	45.889	48.134	46.40
Energy content of final EBW(1+2), Mcal	99.015	152.152	161.794	137.654
Energy gain ,Mcal	71.305	117.395	127.037	105.246
Daily energy gain, ,Mcal	0.6366	1.048	1.1342	0.9397

Each g fat and protein = 9.354 and 5.570 Kcal, respectively.

NE_m values of rations

Mean values for fasting metabolism, ME to maintain energy equilibrium and NE_m of the three rations are shown in Table 2.

TABLE 2: Determination of NE_m Values of rations.

Item	Treatments (rations)			
	I	II	III	Avg.
Net energy maintenance requirement* (Fasting metabolism/day/$W^{0.75}$) (A),Kcal	79.4	79.4	79.4	79.4
ME for maintenance (to maintain energy equilibrium) day/$W^{0.75}$ (B), Kcal	98	98	98	98
Metabolizable energy ME/g feed DM, (c) Kcal	2.034	2.170	2.273	2.159
Amount of feed DM to maintain energy equilibrium/day/$W^{0.75}$ to maintain 98Kcal)(B/C) D,g	48.18	45.16	43.11	45.48
NE_m of rations/g DM $\frac{A}{O}$ E, Kcal	1.648	1.758	1.842	1.749
Efficiency of ME conversion to NE_m,%	81.02	81.01	81.04	81.02

* Rattray, et al. (1973c).

Amount of feed to maintain energy equilibrium every day for the three rations was 48·18, 45·16 and 43·11g/da/w $^{0.75}$ in rations I,II and III respectively ; consequently NE_m values of the three rations were in an opposite trend being 1·648, 1·758 and 1·842. It means that concentration of ration for maintenance increased with the increase in concentrates in ration from 50 to 70%. Rattray *et al.* (1973c) reported 1·75 as average values NE_m of a mixed feed for sheep while reporting 1·67 Kcal/g DM of another ration for lambs (Rattray and Garrett, 1971).

The efficiency of ME conversion to net energy was equal in the three treatments being 81% ; although NE_m values were not equal. It means that sheep utilized the energy of the rations for maintenance, with equal efficiency and that the heat increment produced was the same in the three treatments aside from the source of energy supplied. Blaxter (1966), Maynard and Loosli (1969) and Church (1970) have reported that sheep utilized ME for maintenance very efficiently aside from the source of energy supplied.

NE_g values of rations

When daily feed left for gain, EBW gain and energy gain values are corrected to MBS, the NE_g values of the three rations can be calculated(Table 3).

TABLE 3. **Determination of net energy gain (NE_g) values of feeds.**

Item	Treatments (rations)			
	I	II	III	Avg.
Mean MBS	13.432	14.178	14.495	14.215
Daily DM intake (x), g	1104	1372	1440	1305
Daily DM for maintenance (y), g	647	665	624	645
Daily DM for gain, g	457	707	816	660
Daily EBW gain (x), g	228.30	242.37	229.42	233.40
Daily energy gain(x), Kcal	636.6	1048.2	1134.2	939.7
Daily feed for gain/$W^{0.75}$ (A)	34.02	48.04	56.30	
Daily EBW gain/$W^{0.75}$(B)	17.00	16.47	15.83	16.43
Daily energy gain Kcal/$W^{0.75}$ (c)	47.39	71.22	78.25	65.62
NE_g requirement/day/kg gain/$W^{0.75}$(C/B), Kcal	2.788	4.324	4.943	4.018
NE_g of the feed (C/A), Kcal	1.393	1.483	1.390	1.422

x See data of Table 1.

y Calculated as MBSX daily feed for maintenance (Table2).

Although rations I,II and III contained different energy densities supplied from available carbohydrates (50,60 and 70%), yet NE_g values in the same respective order were different (1·393, 1·493 and 1·393 Kcal/g DM) being equal in rations I and III and at maximum in ration II (containing 60% concentrates and 40% roughages). The reason for that is the energy deposited in bodies of sheep in the three treatments in relation to the amount of feed left for gain, in treatment II, sheep deposited more energy (71·22 Kcal/$W^{0.75}$/da) from 48·04 g of feed DM/$W^{0.75}$ / da, left available for gain.

NE_g values of feedstuffs reported before by sheep were 1·06 (Rattray *et al.* 1973a) ; 1·23 (Rattray *et al.* 1973b), for rations containing 50% concentrates and values ranging from 0·37 to 0·45 for alfalfa hay and from 0·78 to 0·88 Kcal/g/DM for rations containing 40% concentrates (Rattray *et al.* 1973c). NE_g values similar to these was also reported by Garrett *et al.* (1959).

In general, it may be warranted to conclude that the experiment reported here in revealed the following :

1. Efficiency of ME utilization for maintenance in sheep is about 81% aside from the source of energy.

2. Net energy values of feedstuffs containing different levels of concentrates vary for the purpose of gain only and maximum NE_g value was reached when the ration contained 60% concentrates.

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قيم الطاقة الحرارية الصافية الحافظة والانتاجية لعـــلائق تحتوى على نسب مختلفة من المواد الخشنة والمركزة

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أجريت هذه الدراسة فى مزرعة كلية الزراعة ــ جامعة عين شمس بشبرا الخيمة واستخدم فيها تجارب الذبح المقارن على ٣٠ حيوان خليط مرينو × رحمانى عمر ١١ شهر لتقدير الاحتياجات من الطاقة الصافية وكذلك تقدير قيم الطـاقة الصافية للعلائق المستخدمة والمحتوية على نسب مختلفـة من المواد الخشنة والمركزة على أساس معادل النشا وكانت النسب المستخدمة هى ٥٠ : ٥٠ ، ٤٠ : ٦٠ ، ٣٠ : ٧٠ وكانت النتائج كالآتى :

١ ــ قيم الطاقة القابلة للتمثيل للعلائق الثلاثة هى ٢ر٠٣٤ ، ٢ر١٧٠ . ٢ر٢٧٣ كيلو كالورى لكل جم مادة جافة على الترتيب .

٢ ــ قيم الطاقة الصافية الحافظة للعلائق هى ١ر٦٤٨ ، ١ر٧٥٨ ، ١ر٣٩٣ كيلو كالورى لكل جم مادة جافة .

٣ ــ قيم الطاقة الصافية الانتاجية للعلائق هى ١ر٣٩٣ ، ١ر٤٨٣ ، ١ر٣٩٠ كيلو كالورى/جم مادة جافة .

٤ ــ كفاءة التحويل من الطاقة القابلة للتمثيل الى الطاقة الصافية للاحتياجات الحافظة هى ٨١٪ فى العلائق الثلاث بالرغم من اختلاف قيم الطاقة الصافية الحافظة .

٥ ــ الاحتياجات الانتاجية اليومية من الطاقة الصافية هى ٢ر٧٨٨ ، ٤ر٣٢٤ ، ٤ر٩٤٣ كيلو كالورى لكل كجم زيادة فى الوزن من الحيز التمثيلى للأغنام المغذاة على العلائق الثلاث بالترتيب .