

LAMBOT *et al.* (1979) found comparable results : the optimum crude protein concentration for growth and nitrogen utilisation is about 13.3 - 12.2 and 11.4 per cent at body weights of 250, 350 and 450 kg. The effect of the ration protein content is presented in Table 3.

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Danish energy and protein feeding standards for growing and fattening cattle

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Introduction

In Denmark the energy value of feeds as well as the energy requirements of growing animals and milking cows are still expressed as Scandinavian Feed Units (SFU). One SFU is equivalent to the energy content of 1 kg barley (85 per cent dry matter). The advantages of this system are the additivity of energy values of feeds, the simplicity of estimating ration composition for a given production, and the expected production from a defined ration.

The requirements for protein are expressed as digestible crude protein (DCP).

TABLE 1

DANISH ENERGY ALLOWANCES FOR MEDIUM MATURING BULLS AND REPLACEMENT HEIFERS; SFU/DAY

Liveweight kg	Sex	Daily gain, g					
		400	600	800	1 000	1 200	1 400
150	♂	-	1.9	2.4	3.0	3.6	-
	♀	1.2	2.0	2.9	3.9	-	-
200	♂	-	2.4	2.9	3.5	4.1	4.9
	♀	1.6	2.5	3.6	4.7	-	-
250	♂	-	2.8	3.3	4.0	4.7	5.7
	♀	2.0	3.1	4.3	5.6	-	-
300	♂	-	3.2	3.8	4.5	5.4	7.0
	♀	2.3	3.5	4.9	6.7	-	-
350	♂	-	3.6	4.3	5.1	6.4	-
	♀	2.6	3.9	5.6	8.1	-	-
400	♂	-	4.0	4.8	5.8	8.0	-
	♀	2.7	4.2	6.2	-	-	-
450	♂	-	4.5	5.3	6.7	-	-
	♀	-	-	-	-	-	-
500	♂	-	4.9	5.9	8.2	-	-
	♀	-	-	-	-	-	-

Bulls: $ADG = 206.5 - 4.27W + 0.002W^2 + 574.7E - 36.9E^2 + 0.038 (W \times E)$

Heifers: $ADG = 550.8 - 3.83W + 0.006W^2 + 312.5E - 10.3E^2 - 0.27 (W \times E)$

where ADG = daily gain, g; W = liveweight, kg; E = SFU per day

Energy value of feeds

The content of SFU per kg feed dry matter is calculated as:

$$SFU = (1.43.X_1 + k.X_2 + 1.00.X_3 + 1.00.X_4) \times \left(\frac{V}{0.75} \right)$$

where SFU = Scandinavian feed units per kg dry matter

X_1 = digestible crude protein, per cent of dry matter

X_2 = digestible crude fat, per cent of dry matter

X_3 = digestible crude fibre, per cent of dry matter

TABLE 2
EXPERIMENTS USED TO CALCULATE THE ENERGY ALLOWANCES FOR BULLS AND STEERS

Exp. no.	No. of animals	Breed	Sex	Weight at slaughter	Relative feeding level
Ka 416	168	RDM	♂	180-540	100-55
Ka 41	120	SDM	♂ ¹ + ♂ ²	425-800	100-70
Ka 49	420	Crosses	♂	320-560	100-70

X_1 = digestible N-free extract, per cent of dry matter

k = 2.41 for concentrates

k = 2.12 for grains

k = 1.91 for roughages (1.00 for silage and hay)

V = value number.

In most cases the coefficients of digestion are determined in experiments with mature sheep fed 1 kg DM/day. The value number is determined in feeding trials with dairy cows. The digestibility coefficients and the value number of silage and hay may be calculated by regressions from the content of crude protein, crude fibre and ash.

Compared to other systems, e.g. fattening feed unit and starch equivalent, the SFU system overestimates the energy value of protein rich feeds because of a higher protein factor (1.43 vs 0.94). The nutritive value of various feeds is published in a booklet (ANDERSEN and JUST, 1975) which is revised approximately every five years.

Energy allowances for both bulls and replacement heifers (Table 1) have been determined from the relationship between daily gain and daily intake of SFU in feeding trials. The advantage of this procedure is, for example, that the allowance takes into consideration those differences in energy requirements for maintenance and gain which may exist due to differences in the level of feeding.

Energy requirements in bulls and steers, as well as the effects on carcass and meat quality, are under investigation in three experiments (Table 2). All experiments are initiated with calves at 73 days of age.

TABLE 3
EXPERIMENTS USED TO CALCULATE THE ENERGY ALLOWANCES FOR HEIFERS

Exp. no.	No. of animals	Breed	Gain per group at 300 kg; g/day		Feeding method
			min.	max.	
Ka 76	34	RDM	597	658	Restricted
Ka 98	69	RDM	685	918	Restricted
U 5	48	SDM	773	1032	<i>Ad libitum</i> ^a
U 6	96	RDM	354	926	<i>Ad libitum</i> ^b

^a Silage/concentrate

^b Barley straw/fodder sugar beets/concentrate

TABLE 4

DANISH ALLOWANCES OF DIGESTIBLE CRUDE PROTEIN FOR MEDIUM MATURING YOUNG BULLS AND REPLACEMENT HEIFERS

Weight interval, kg	Digestible crude protein, g/SFU	
	Bulls ^a	Replacement heifers ^b
-100	155	155
100-150	135	140
150-200	115	125
200-250	100	110
250-300	90	95
300-350	85	85
350-400	80	75
400-450	75	75
450-500	75	75

^aSørensen and Kousgaard, 1976.

^bSteensberg, 1947; Jensen et al., 1949.

The level of feeding is controlled by restricted feeding ; the energy concentration of the total ration (SFU/kg DM) and DCP/SFU are kept constant. Only the first experiment (Ka 416) has been completed (ANDERSEN, 1975) and the energy allowances in Table 1 are based on that experiment. However, expected daily gains calculated by the regression for bulls in Table 1 are in agreement with daily gains obtained in feeding experiments with bulls fed various roughages : concentrate rations *ad libitum* and average results for more than 1 000 RDM and SDM bulls on performance test stations. The energy allowance will be revised when all the experiments in Table 1 are completed.

The daily energy allowances for replacement heifers (Table 1) (FOLDAGER *et al.*, 1978) are calculated from feeding experiments where the main purpose was to estimate the optimum rearing intensity (Table 3).

In these trials the SFU/day were varied either by restricted feeding or free access to rations with various roughage : concentrate ratios. There was good agreement between daily gains for groups on restricted feeding and those fed *ad libitum*.

Protein allowances

The protein recommendations for young bulls and replacement heifers are shown in Table 4.

The recommendation for bulls (SØRENSEN and KOUSGAARD, 1976) was determined in feeding trials and included more than 400 animals. The feeding method was semi-*ad libitum* and the feeds were mainly grains and fodder sugar beets. The variable protein source was mainly soyabean meal but larger bulls were also fed mixtures of vegetable protein sources (soyabean meal, cotton seed cake, sunflower cake). The overall daily gains were 1 000 - 1 200 g. It has not been clarified whether the recommendations in Table 4 are adequate when the energy intake is restricted and/or young bulls are fed rations containing more roughage than used in the experiments.

The recommendation for replacement heifers is based on experiments conducted in the forties (STEENBERG, 1947 ; JENSEN *et al.*, 1949). In these trials there was a total of 124 heifers. The experimental period was from birth to calving, and the daily allowance of SFU was in accordance with a standard for moderate feeding (the overall average daily gain was 400 - 500 g). The heifers were at pasture during the summer periods. The allowance used is according to age but it has since been converted to recommendations for weight intervals.

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**Finnish energy and protein feeding standards
for growing and fattening cattle**

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The official Finnish recommendations date from 1962 but they are no longer in use. The recommendations given here, although they are unofficial (MELEN, 1976), are widely followed. They are used in those feeding tables which are calculated for almost every herd belonging to the milk control system.

TABLE 1

ENERGY (FFU/day) AND PROTEIN RECOMMENDATIONS FOR GROWING BULLS

Liveweight kg	Liveweight gain, g/day						g DCP/ day
	700	800	900	1 000	1 100	1 200	
100-150	2.8	2.9	3.0	3.2	3.4	3.7	138
150-200	3.1	3.3	3.5	3.8	4.1	4.5	128
200-250	3.4	3.7	4.0	4.4	4.8	5.3	119
250-300	3.8	4.2	4.5	5.0	5.5	6.1	113
300-350	4.2	4.7	5.1	5.7	6.3	7.0	108
350-400	4.7	5.2	5.7	6.4	7.1	7.9	105
400-450	5.2	5.8	6.4	7.1	7.9	8.8	102
450-500	5.8	6.4	7.1	7.9	8.8		100