The influence of loss and gain of body mass on ovarian activity in beef cows

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Ovarian activity was studied in 36 dry, *Bos taurus* cows fed to achieve different rates of body mass loss and gain in a 2 × 2 factorial experiment. Cows were fed hay to supply either 70% (Treatments 1, 2) or 40% (Treatments 3, 4) of their ME requirements for maintenance until they became anoestrus. Following a 90-day period during which body mass was maintained the animals were fed hay *ad lib.* and either 1 kg (Treatments 1, 3) or 4 kg (Treatments 2, 4) of maize per cow per day until they resumed luteal activity. During the initial 14 days after maize feeding commenced each cow was weighed every second day in order to obtain an estimate of gutfill. Oestrous activity was monitored twice daily by observing marker bulls joined with cows. Ovarian activity was assessed each week throughout the trial by palpation of the ovaries per rectum. Ovarian activity did not cease in four cows, despite a loss of about 31% of initial mass. One cow died during the course of the experiment. Thirty-one cows lost approximately 100 kg or 21% of their initial mass, and 1,1 condition score points over a period of about 5 months before they became anoestrous. Treatment did not influence mass and condition losses and gains and the time taken for cows to cease and resume ovarian activity. Gutfill was estimated at 25,9 ± 10,5 kg. Cows were between 35 and 57 kg heavier ($P < 0,01$) at the resumption than at the cessation of ovarian activity. The estimate of gutfill in each cow was subtracted from the actual mass at resumption of ovarian cycles. At the resumption of ovarian activity the mean adjusted mass (389,9 ± 44,9 kg) was significantly ($P < 0,01$) greater than that at the cessation of ovulatory cycles (368,6 ± 39,1 kg). The mean condition score at resumption of ovulation (2,35 ± 0,34) was also significantly ($P < 0,01$) higher than that at cessation of ovarian activity (1,72 ± 0,37). Treatment did not influence conception rates in cows. Over all treatments 85% of the cows conceived to service at the resumption of ovulatory activity.

In 'n 2 × 2-faktoriale proef is ovariale aktiwiteit ondersoek in 36 droë *Bos taurus*-koeie wat gevoer is om verskillende tempo's van massaverlies en massatoename te ondergaan. Koeie is hooi gevoer om 70% (Behandelings 1, 2) of 40% (Behandelings 3, 4) van hulle ME-behoeftes vir massa-onderhoud te voorsien totdat anestrus ingetree het. Na 'n periode van 90 dae waartydens massa konstant gehou is, is die koeie *ad lib.* hooi, en óf 1 kg (Behandelings 1, 3), óf 4 kg (Behandelings 2, 4) mieliemeel per koei per dag gevoer totdat eierstokaktiwiteit weer hervat is. Gedurende die eerste 14 dae van die periode waartydens mieliemeel gevoer is, is alle koeie elke tweede dag geweeg om 'n aanduiding van ingewandevul te kry. Eierstokaktiwiteit is vir die duur van die proef gemonitor deur daaglikse estruswaarnemings met behulp van merkerbulle, en weeklikse rektale ondersoeke van die eierstokke. In vier koeie het eierstokaktiwiteit nie gestaak nie, ten spyte van massaverliese van ongeveer 31% van aanvanklike massa. Een koei het gevrek gedurende die proef. Een-en-dertig koeie het ongeveer 100 kg of 21% van hul aanvanklike massa, en 1,1 van 'n kondisietelling verloor oor 'n periode van ongeveer 5 maande voordat anestrus ingetree het. Behandeling het nie massa- en kondisieveranderings en die tydsduur tot die staking en hervatting van eierstokaktiwiteit beïnvloed nie. Ingewandevul is op 25,9 ± 10,5 kg beraam. Koeie was tussen 35 en 57 kg swaarder ($P < 0,01$) tydens die hervatting as met die staking van eierstokaktiwiteit. Die beraming van ingewandevul is afgetrek van die werklike massa tydens die hervatting van eierstokaktiwiteit. Die gemiddelde gekorrigeerde massa by die hervatting van eierstokaktiwiteit (389,9 ± 44,9 kg) was betekenisvol ($P < 0,01$) groter as die met die intrede van anestrus (368,6 ± 39,1 kg). Die gemiddelde kondisiestelling by die hervatting van ovariale siklusse (2,35 ± 0,34) was ook betekenisvol ($P < 0,01$) hoër as toe anestrus ingetree het (1,72 ± 0,37). Behandeling het nie konsepsiesyfers in koeie beïnvloed nie. Oor al die behandelings het 85% van die koeie beset geraak met die hervatting van ovulasie.

Keywords: Beef cows, ovarian activity, body mass, anoestrus

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Introduction

Without adequate winter dietary supplementation beef cows can loose 10% or more of their autumn mass in the sourveld areas of South Africa (Reyneke, 1971). Such losses in mass result in cows failing to achieve their 'target mass' at the start of the mating season, and consequently they are likely to achieve poor conception rates (Meaker, Coetsee, Smith & Lishman, 1980). Hale (1975) proposed two strategies whereby cows can be fed to achieve their 'target mass' at mating. Cows could be allowed to lose mass during winter, after which they are fed to regain this loss (during summer) before the bulling season. Alternatively, it may be economically and physiologically more efficient to maintain cows in good condition throughout the year. Results obtained by Hale (1975) favour the latter strategy. He found that following severe mass losses resulting in anoestrus, cows had to regain more mass than they had lost, before they resumed ovarian activity. Thus, 'interest was paid' on the mass lost before cows become anoestrus. Hale (1975) did not obtain an estimate of gutfill in his cows. While gutfill can account for 12 – 23% of live mass in well-nourished animals (Tayler, 1954; Hughes, 1976), the contribution to live mass is likely to be relatively small in animals subjected to severe feed restriction. Therefore, in the experiment conducted by Hale (1975) part of the observed increase in body mass between cessation and resumption of sexual activity may have been due to gutfill. The present study was initiated to determine changes in mass and condition required for cows to cease and then resume ovarian activity and to annul the contribution of gutfill to these changes. Furthermore, body condition changes and the rate of change in body mass was studied.

Procedure

During August 1983, prior to the start of the experiment, 36 mature, non-pregnant, beef cows (32 Simmentaler × Hereford and four Sussex) were fed maize silage and *Eragrostis curvula* hay until their condition score was approximately 3 (1 = thin; 5 = fat; Van Niekerk & Louw, 1982). During the pre-experimental period, cows were run continuously with vasectomized bulls fitted with chinball markers in order to allow detection of oestrus. All cows were found to be cycling normally. The experiment was conducted in feeding pens and comprised three phases: Phase 1, the induction of severe mass losses until cows became anoestrus; Phase 2, maintenance of body mass for a 90-day period; Phase 3, rapid mass gain until ovulatory cycles were re-established. The cows were allocated to one of four treatments in a 2 × 2 factorial design. During Phase 1 cows were fed hay to supply either approximately 70% (Treatments 1, 2) or 40% (Treatments 3, 4) of their metabolizable energy (ME) requirements for maintenance. Cows in Treatments 1 and 2 were all fed together during Phases 1 and 2, as were the cows allocated to Treatments 3 and 4. During Phase 3, two rates of body mass gain were imposed by feeding cows hay *ad lib.* and either 1 kg (Treatments 1, 3) or 4 kg of maize per cow per day (Treatments 2, 4). The quantities of roughage and grain fed during the three phases are summarized in Table 1. The initiation of Phases 2 and 3 did not occur simultaneously in all animals, but was staggered on an individual cow basis, according to the date on which each cow ceased ovulatory activity.

Table 1 Daily quantities of *Eragrostis curvula* hay and maize fed per cow during the three phases of the trial

Treatment	*n*	Phase 1 (Mass loss)	Phase 2 (Maintenance)	Phase 3 (Mass gains)
1	9	4,6 kg hay	Quantity of hay	Hay *ad lib.* plus 1 kg maize
2	10	4,6 kg hay	varied to result	Hay *ad lib.* plus 4 kg maize
3	10	2,9 kg hay	in mass main-	Hay *ad lib.* plus 1 kg maize
4	7	2,9 kg hay	tenance	Hay *ad lib.* plus 4 kg maize
Total	36			

During Phases 1 and 2 the cows were joined with vasectomized bulls fitted with chinball markers, and during Phase 3 they were run with fertile bulls. Each week for the duration of the trial all cows were rectally palpated for the presence of *corpora lutea.* Ovarian examination revealed that the mating of cows by teasers and/or fertile bulls was not an accurate indicator of ovulation. Thus, some cows were mounted by bulls midway through the 3-month period during which ovaries were quiescent. Consequently, the date on which cyclic activity ceased (end of Phase 1) was taken as being the last day on which a *corpus luteum* was detected, when followed by a 12-week period of ovarian quiesence. Similarly, the date on which a *corpus luteum* was first palpated during Phase 3 was regarded as that on which cyclic activity resumed. Both the calving dates and the dates on which ovulatory cycles were observed to have resumed were used to estimate the dates of conception.

Cows were weighed weekly, and their condition scored at fortnightly intervals during the trial. Water and feed were not withheld prior to weighing. An attempt was made to estimate gutfill in cows fed the *ad lib.* ration during Phase 3. For this purpose cows were weighed at 2-day intervals for the initial 14 days of Phase 3. Again, water and feed were not withheld prior to weighing.

Analysis of variance was used to test the influence of treatment on changes in mass and condition in cows. The Student's *t* test on paired observations was used to test for differences between masses and condition scores measured at different stages of the experiment. The influence of treatment on conception rate was examined by the chi-square test.

Results

One of the 36 cows died during the course of the experiment. This cow ceased ovulatory cycles 104 days after the start of the trial, having lost 98,6 kg (22%) of her initial mass (448,6 kg). Despite being given free access to feed this cow continued to lose body mass and died having lost an additional 44 kg over a 73-day period. At death her condition score was 1,0. Four of the 36 cows (11,1%) did not cease ovarian activity within 239 days of the start of the trial, despite drastic mass and condition losses. These cows lost 152,2 ± 14,9 kg (31,3 ± 5,1%) of their initial mass and their condition score declined to 1,1 ± 0,3, having been 2,94 ± 0,1 at the start of underfeeding. These animals were removed from the trial to avoid further deaths. Thirty-one cows completed the trial and only data of these animals are included hereafter.

During Phase 1 the cows lost approximately 100 kg or 21% of their initial mass, over a period of about 5 months, before ovulatory activity ceased (Table 2). Cows lost approximately 1,1 condition score points until they ceased ovulation, when their score was about 1,7. Sexual activity ceased earlier (15 days) and after greater loss of body mass (11 kg) in cows fed 40% of their maintenance requirements than in those fed 70% of requirements. However, these differences due to varying

Table 2 Mean mass and condition score changes during Phase 1 (rapid mass loss)

	Treatments	
	1, 2 (70% of ME for maintenance)	3, 4 (40% of ME for maintenance)
n	15	16
Initial mass (kg)	472,4 ± 52,3	471,1 ± 50,0
Days to cessation of ovulation	168,5 ± 35,7	153,8 ± 35,9
Mass at cessation of ovulation (kg)	375,2 ± 47,4	362,5 ± 29,6
Mass loss to cessation of ovulation (kg)	97,2 ± 24,4	108,6 ± 26,4
% of initial mass lost to cessation of ovulation	20,7 ± 4,9	22,8 ± 3,7
Average daily mass change to cessation of ovulation (kg/day)	-0,60 ± 0,20	-0,73 ± 0,20
Initial condition score	2,77 ± 0,33	2,91 ± 0,26
Score at cessation of ovulation	1,67 ± 0,37	1,77 ± 0,37
Score loss to cessation of ovulation	1,1 ± 0,42	1,14 ± 0,34

nutrient intakes were not significant (Table 2).

During Phase 2 cows allocated to Treatments 1 and 2 lost 0,2 ± 0,29 kg/day and cows in Treatments 3 and 4 lost 0,09 ± 0,2 kg/day. The difference between these gains was not significant. Figure 1 illustrates changes in body mass during the first 14 days of Phase 3. Mass increases of approximately 28 kg occurred within the first 4 days, and this gain represented most (94,2%) of the mass gained over the first 14 days. It is generally accepted that live mass gains of this magnitude, over a 4-day period, are not physiologically possible. It was therefore assumed that the rate of real change in body mass between days 0 and 4 was the same as that between days 4 and 14. The balance of the gain measured between days 0 and 4 was assumed to represent gutfill. In all cows the mean estimate of gutfill was 25,9 ± 10,5 kg or 7,2 ± 2,9% of the mass measured on day 0 of

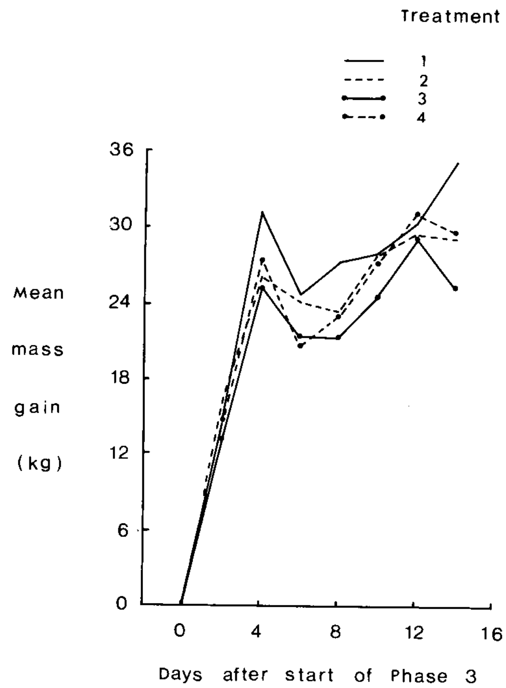

Figure 1 Mean mass gains in cows during the initial 14 days of Phase 3

Phase 3. Estimates of gutfill were not affected by treatment.

Treatment did not significantly influence mass gains during Phase 3 (Table 3), although cows in Treatments 2 and 4 (which each received 4 kg of maize per day) gained between 0,1 and 0,2 kg/day more than those in Treatments 1 and 3 (fed 1 kg of maize per day). None of the cows experienced digestive upsets following realimentation. Cows fed 4 kg of maize per day during Phase 3 did not resume ovarian activity consistently earlier than those fed 1 kg of maize per day. Thus, cows in Treatment 2 resumed ovarian activity an average of 25 days later than those in Treatment 1, whereas cows in Treatment 4 recommenced ovulatory cycles 20 days earlier than those in Treatment 3 (Table 3). For each

Table 3 The influence of treatment on mean mass changes during Phase 3 (rapid mass gains), and masses at cessation and resumption of ovulation

	Treatment			
	1	2	3	4
n	6	9	10	6
Estimated gutfill (kg)	30,4 ± 4,5	24,1 ± 16,1	25,0 ± 5,7	25,9 ± 11,6
Days from start of Phase 3 to resumption of ovarian activity	70,3 ± 39,3	94,7 ± 62,4	69,5 ± 37,9	49,2 ± 31,5
ADG from start of Phase 3 to resumption of ovarian activity (kg/day)[ab]	0,33 ± 0,35	0,41 ± 0,38	0,24 ± 0,43	0,47 ± 0,41
Mass when ovarian activity:				
Ceased (kg)	368,2 ± 48,2 } *	379,8 ± 49,1 } **	367,0 ± 32,4 } **	354,9 ± 24,9 } *
Resumed (kg)	424,8 ± 70,8	427,2 ± 53,0	402,4 ± 29,7	412,1 ± 42,3
Resumed minus gutfill (kg)	394,4 ± 70,2	403,1 ± 48,8	377,4 ± 27,6	386,2 ± 36,5
Mass change from cessation to resumption of ovarian activity (kg)[b]	26,2 ± 38,6	23,3 ± 35,0	10,4 ± 24,0	31,3 ± 34,3

[a]ADG: Average daily gain; [b]This gain excludes that due to gutfill;
Means joined vertically differ significantly from each other (*$P < 0,05$; **$P < 0,01$)

Table 4 The influence of treatment on mean condition scores at the cessation and resumption of ovarian activity

	Treatment			
	1	2	3	4
Score at cessation of ovulatory cycles	1,58 ± 0,49 }**	1,72 ± 0,29 }**	1,85 ± 0,44 }*	1,63 ± 0,14 }*
Score at resumption of ovulatory cycles	2,37 ± 0,22	2,39 ± 0,36	2,25 ± 0,26	2,46 ± 0,53
Score change from cessation to resumption of ovulatory cycles	0,78 ± 0,45	0,67 ± 0,39	0,4 ± 0,39	0,83 ± 0,52

Means joined vertically differ significantly from each other(* $P < 0,05$; ** $P < 0,01$)

treatment, the mean mass at which cows resumed ovarian activity was significantly ($P < 0,05$) greater than that at which they become anoestrus. The magnitude of the difference between masses at the aforementioned stages was not influenced by treatment. Estimates of gutfill were subsequently subtracted from the actual masses, to obtain adjusted masses at the resumption of ovarian activity. For each individual treatment the adjusted masses at resumption did not differ from those at the cessation of ovulation. However, after pooling data from all cows the mean adjusted mass at resumption (389,9 ± 44,9 kg) was significantly ($P < 0,05$) greater than that at the cessation of ovarian activity (368,6 ± 39,1 kg).

Actual condition scores, and the magnitude of the difference between these at the cessation and resumption of ovarian activity were not influenced by treatment (Table 4). However, within each treatment the mean score at the re-initiation of ovulation was significantly ($P < 0,05$) higher than that at which cows became anoestrus. Scores obtained at the cessation of ovulatory activity were pooled, as were those measured in all cows at the resumption of ovulation. The mean score at the re-establishemnt of ovulation (2,35 ± 0,34) was significantly ($P < 0,01$) higher than that measured when cows became anoestrus (1,72 ± 0,37).

The number of cows which conceived during Phase 3, and the stage, mass and condition score at which conception occurred was not influenced by rate of mass loss and gain (Table 5). A notable feature of the results presented in Table 5 is that the vast majority of cows conceived at the resumption of ovulatory cycles. Thus, over all treatments 85% (22/26) of the cows which conceived did so at the reinitiation of sexual cycles. The four cows which conceived later became pregnant between 28 and 124 days after re-establishment of ovulatory cycles. Five cows failed to conceive, despite having been exposed to fertile bulls for at least 21 and at most 144 days after the resumption of ovarian cycles. After pooling data obtained in all animals, the cows (22) which conceived at the resumption of ovulation were compared to those (9) which failed to do so, in respect of

Table 5 The influence of treatment on conception rates in cows (see Table 1 for description of treatments)

	Treatment			
	1	2	3	4
n	6	9	10	6
Cows which conceived at resumption of ovulation				
No	5	6	6	5
Mean mass at resumption of ovulation (kg)	414,0 ± 73,4	420,2 ± 54,3	397,2 ± 19,6	433,3 ± 44,7
Mean condition score at resumption of ovulation	2,34 ± 0,23	2,5 ± 0,35	2,25 ± 0,27	2,25 ± 0,27
Cows which conceived after resumption of ovulation				
No	0	1	2	1
Days from resumption of ovulation to conception in individual cows	—	76	36; 124	28
Mean mass at resumption of ovulation (kg)	—	456,7	437,2 ± 50,1	376,8
Mean condition score at resumption of ovulation	—	2,0	2,25 ± 0,35	2,0
Mean mass at conception (kg)	—	536,2	480,8 ± 88,0	382,7
Mean condition score at conception	—	3,0	3,0 ± 0	2,0
Cows which did not conceive				
No	1	2	2	0
Days exposed to fertile bulls after resumption of ovulation in individual cows	92	21; 92	92; 114	—
Mean mass at resumption of ovulation	479,0	433,0 ± 80,0	397,5 ± 6,1	—
Mean condition score at resumption of ovulation	2,5	2,25 ± 0,35	2,0 ± 0,0	—
Mean mass at termination of trial (kg)	561,1	510,3 ± 28,2	468,5 ± 33,4	—
Mean condition score at termination of trial	3,0	3,0 ± 0,0	3,25 ± 0,35	—

Table 6 Mean mass and condition changes in cows that did and did not conceive at the resumption of ovulation

Parameter	Cows which conceived at resumption of ovulation	Cows which failed to conceive at resumption of ovulation
n	22	9
Mass at commencement of Phase 1 (kg)	455,3 ± 45,2[a]	511,7 ± 39,8[b]
Mass loss during Phase 1 (kg)	97,0 ± 25,0[a]	117,9 ± 22,3[b]
% of initial mass lost during Phase 1	21,2 ± 4,4	23,3 ± 4,1
Mass at cessation of ovulation (kg)	358,3 ± 36,1[a]	393,8 ± 36,0[b]
Ratio: $\frac{\text{Mass at resumption}}{\text{Mass at cessation}} \times \frac{100}{1}$	115,1 ± 7,3[a]	107,9 ± 9,9[b]
Condition score at commencement of Phase 1	2,78 ± 0,31	2,97 ± 0,23
Condition score loss during Phase 1	1,11 ± 0,42	1,13 ± 0,25
% of initial score lost during Phase 1	39,4 ± 13,6	37,2 ± 9,0
Condition score at cessation of ovarian activity	1,67 ± 0,4	1,84 ± 0,3

Within the same row means with different superscripts differ significantly ($P < 0,05$) from each other

a number of parameters (Table 6). Cows which failed to conceive were significantly ($P < 0,05$) heavier at the start of the trial, lost more mass during, and were heavier at the end of Phase 1, than those which ultimately became pregnant at the resumption of ovarian activity. Corresponding measures of condition did not differ between the two groups of cows. Cows which conceived were 15,1% heavier at the resumption than at the cessation of ovulation, as against a corresponding mass increase of only 7,9% in cows which failed to conceive (Table 6).

Discussion

The main objective of this study was to establish to what extent severe undernutrition influences subsequent reproductive ability in beef cows. The results presented in Tables 3 and 4 clearly indicate that cows were significantly heavier and in better condition when they resumed, relative to when they ceased ovarian activity. This finding, which concurs with that of Hale (1975) has important practical implications. Dry, non-pregnant cows should be placed on winter feeding regimes which prevent mass losses resulting in cows becoming anoestrus. This strategy will obviate the necessity of feeding cows to gain mass and condition beyond that at which anoestrus had previously set in. On the basis of results obtained in this study it is interesting to speculate that the 'target mass' for a particular conception rate in lactating beef cows may be influenced by previous nutritional history. Cows which undergo a period of anoestrus induced by severe mass losses may later (when lactating) have a higher 'target mass' than cows not subjected to severe feed restriction. In this context it is interesting to note that heifers which experience a prolonged period of undernutrition have a higher 'target mass' (for a particular conception rate) than their well-fed contemporaries (Sparke & Lamond, 1968; Wiltbank, Kasson & Ingalls, 1969).

Hale (1975) and Richards, Wettemann & Schoenemann (1986) conducted similar, but not identical experiments to the one described in the present study. According to the limited information reported by Hale (1975) cows subjected to severe undernutrition lost about 68 kg or 21,2% of their initial mass over a period of about 135 days before they become anoestrus. This agrees closely with the 21,7% of initial mass lost over a period of about 150 days in the present study (Table 2). Richards, *et al.*, (1986) recorded mass losses of approximately 24% in underfed cows over a period of 182 days, at the end of which 91% of the animals had ceased luteal activity. In the study by Hale (1975) cows were 70 kg heavier at resumption than at cessation of ovarian activity, but gutfill was not estimated. When the estimate of gutfill obtained in the present study (about 25 kg; Table 3) is subtracted from the aforementioned increase in mass obtained by Hale (1985), the cows in his study would have been 45 kg heavier at resumption than at cessation of ovarian cycles. This mass increase is considerably greater than the 21 kg recorded in the present study (Table 3). The different breeds and rates of mass change used could account for this discrepancy but the principle of cows being heavier when they resumed relative to when they ceased ovarian activity is now clearly established. In the study by Richards, *et al.*, (1986) condition scores, but not masses were higher at the return to, than at the cessation of sexual cycles. Donaldson & Takken (1968) established the same principle for heifers, which, following severe feed restriction, were significantly lighter on becoming anoestrus than when later returning to oestrus following a period of *ad lib.* feeding.

Four of the cows used in the present study failed to become anoestrus, despite having lost about 152 kg or 31% of their initial mass. Breed-type could influence the magnitude of mass and condition losses that cows can tolerate prior to ceasing ovarian activity, a theory substantiated by the work of Hale (1975). Dry Africander cows lost 19%, and Mashona cows 32% of their initial mass before they stopped sexual activity. The majority of South African beef cattle are *Bos indicus* types. Differences in reproductive function between *Bos indicus* and *Bos taurus* cattle are well documented (Anderson, 1936; Plasse, Warnick & Koger, 1968; Randel, 1976; Rhodes, Randel & Harms, 1978). Further research is required to establish whether *Bos indicus* cows would cease sexual activity after losing more or less of their initial mass and condition than the *Bos taurus* cows used in the present study.

The estimate of gutfill obtained in this study can at best be regarded as an approximation, but an attempt to gauge its magnitude was considered essential. The mass increase of about 25 kg between stages at which cows ceased and resumed ovarian activity should be regarded as the minimum, because strictly speaking an estimate of gutfill should have been obtained, and subtracted from the masses at which cows ceased ovulatory activity. However, it was reasoned that the contribution of gutfill to live mass was relatively small at this stage, when each cow was fed only between 2,9 and 4,6 kg of hay per day. Gutfill was estimated to constitute about 7% of live mass at the commencement of 'full feeding' (Phase 3). This is a relatively small proportion when considering that Tayler (1954) and Hughes (1976) maintain that gut contents can constitute 12 to 22% of an animal's mass. It is likely though that a degree of 'rumen shrink' occurred during the months of feed restriction, which could explain the relatively small contribution of gutfill to live mass in this study.

A surprising feature of the results presented in Table 5 was that the majority of cows conceived immediately on resuming ovarian activity. A varying proportion of lactating cows commonly experience 'short' oestrous cycles during the transition from anoestrus to the resumption of normal ovarian activity (Short, Randel & Bellows, 1974) and in dairy cows conception rates at the first oestrus after calving are poorer than at subsequent heat periods (Olds & Cooper, 1970). Beef heifers have reduced follicle numbers and plasma progesterone levels when subjected to short-term undernutrition (Hill, Lamond, Henricks, Dickey & Niswender, 1970). On the other hand it was shown by Richards, *et al.* (1986) that undernourished anoestrous cows, on being fed to resume sexual activity, conceived as rapidly as dry cows fed to maintain mass over an extended period. This finding, together with that of the present study indicate that in the majority of dry cows the anoestrous state induced by severe undernutrition can be rapidly changed to one of normal fertility, once cows have regained sufficient mass and condition to reinitiate oestrous cycles. A small number of cows failed to conceive, despite having been exposed to fertile bulls for as long as 124 days after the reinitiation of ovulatory cycles (Table 5). These cows may have undergone undetected embryonic failure or abortion, or fertilization failure due to structural abnormalities such as blocked fallopian tubes. The data summarized in Table 6 suggest that size of cow may influence conception rates following severe feed deprivation. Cows which failed to conceive on resuming ovarian function were initially heavier than, but in similar condition to those which conceived, suggesting that the cows which failed to conceive were larger than those which became pregnant. Cows which experienced conception failure resumed ovarian cycles when only 7,9% heavier than when they became anoestrus, as against a corresponding mass increase of 15,1% in cows which conceived on returning to sexual activity (Table 6). Relatively large cows may thus experience lower conception rates following severe mass losses than smaller cows.

Treatment, that is the different rates of mass loss and gain, did not influence the length of the periods to, and the magnitude of mass and condition losses and gains until cessation and resumption of ovulatory cycles (Tables 2, 3, 4). This finding was surprising, when considering the size of treatment differences. It is thus clear that differences in dietary levels need to be relatively large when studying ovarian responses at sub-maintenance nutritional levels. It is also clear from the results of this study that dry, non-pregnant, beef cows can be fed as little as 2,9 kg of hay per day for as long as 5 months during conditions of feed scarcity, providing physical activity is restricted. Furthermore, with restoration of nutritional levels the majority of such cows will resume normal reproductive ability, albeit at masses and conditions significantly greater than when sexual activity had previously come to a halt.

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