DROUGHT FEEDING STUDIES WITH CATTLE

6. SORGHUM SILAGE, WITH AND WITHOUT UREA, AS A DROUGHT FODDER FOR CATTLE IN LATE PREGNANCY AND EARLY LACTATION

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SUMMARY

Three groups, each of 10 pregnant Hereford heifers, were confined in bare yards when their mean stage of gestation was 175 days. All groups received a basal ration of sorghum silage *ad lib.* One group received no supplement, while the other two groups were fed a supplement of 1.5 oz and 2.5 oz of urea per head per day respectively. The experiment terminated after 24 weeks, when the mean stage of lactation of animals suckling calves was 62 days.

Heifers receiving no supplement lost an average of 150 lb body-weight prior to calving. This body-weight loss was significantly higher than those of 79 lb and 42 lb in the two groups receiving 1.5 oz and 2.5 oz of urea per head per day respectively. The average body-weight loss for those animals suckling calves at the conclusion of the experiment was 385 lb in the group receiving no supplement. The body-weight losses for comparable animals in the groups receiving 1.5 oz and 2.5 oz of urea per head per day were 286 lb and 236 lb respectively.

Urea supplementation increased silage consumption. The mean daily consumption of dry matter per head in each group was: no supplement, 6.3 lb; 1.5 oz urea, 9.0 lb; 2.5 oz urea, 10.2 lb.

The average birth weight of the calves born to heifers in the group receiving no urea was 48.4 lb and was significantly lower than that of 55.6 lb in the calves born to heifers in the group receiving the higher level of urea.

Deaths of 4 calves in the non-supplemented group were attributed to the experimental treatment. No calves died in the group receiving 1.5 oz of urea, while there was one death in the group supplemented with 2.5 oz of urea.

The average body-weight gain in calves from birth to 28 days of age was 9.4 lb in the non-supplemented group and 23.3 lb and 16.4 lb in the groups supplemented with 1.5 oz and 2.5 oz of urea respectively.

Milk production was obtained over a 24-hr period at the conclusion of the experiment by hand-milking the animals after oxytocin injections. The yield was significantly higher in the two groups receiving urea than in the non-supplemented group.

The overall incidence of both dystokia and retained placenta was 15 per cent. There were no significant differences between groups.

At the conclusion of the experiment, there were no significant differences among group means in serum total protein, albumin and globulin; plasma chloride, sodium and potassium; and blood haemoglobin and packed cell volume. After 24 weeks on silage the values in all groups for serum total protein and plasma sodium were significantly lower than initial values.

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I. INTRODUCTION

Previous papers in this series have reported results on the use of native pasture hay (Morris 1958*a*), sorghum silage with and without urea (Morris 1958*b*) and restricted rations of sorghum grain (Morris 1958*c*; Ryley, Gartner, and Morris 1960) as drought fodders for non-pregnant heifers. These experiments, together with those of Southcott and McClymont (1960*a*, 1960*b*) on the feeding of hay-grain and all-grain rations to steers and non-pregnant heifers, have provided information on the survival requirements of these classes of animals, fed under pen conditions on fodders that could be conserved on many beef cattle properties in Queensland. As heifers must be considered as the potential breeding herd, it was most desirable to obtain these data before studying the survival requirements of other classes of cattle.

From survey data collected by the Queensland Department of Agriculture and Stock, it is apparent that the highest mortality in cattle during droughts occurs in pregnant and lactating animals. This is due to the higher nutritional requirements in late pregnancy and in lactation, together with the additional stress of calving. The next stage in the series of investigations on drought feeding at the Animal Husbandry Research Farm, Rocklea, Brisbane, has been concerned with the survival requirements of pregnant heifers and lactating cows and their calves.

The aim of the experiment reported in this paper was to investigate the value of sorghum silage, comparable in composition to that which has been produced in western Queensland, as a fodder for cattle in late pregnancy and early lactation. The silage was fed either as the sole ration or supplemented with two levels of urea. Data were obtained on changes in body-weight, voluntary silage consumption, milk production and incidence of dystokia and retained placenta in heifers, and on birth weight, mortality and growth rate of their calves. Determinations were made of total serum protein, albumin and globulin; plasma chloride, sodium and potassium; and blood haemoglobin and packed cell volume of heifers and calves.

II. MATERIALS AND METHODS

(i) *Sorghum Silage*.—The sorghum used in this experiment (*Sorghum vulgare* var. Sugardrip) was grown at the Animal Husbandry Research Farm on land that had been under cultivation for a number of years. No fertilizer treatment was applied. The crop was harvested with a forage harvester and chopper 106-118 days after planting. At this stage it was approximately 10 ft high and the seed was in the soft to hard dough stage. It was ensiled over a period of 12 days in a hillside trench silo with a capacity of approximately 240 tons. The method of ensiling and the design of the silo were similar to those described by Morris (1958*b*).

Twenty-two months after ensiling, the trench was opened on a vertical face and silage removed daily for experimental feeding.

(ii) *Experimental Animals*.—Thirty-four dehorned maiden Hereford heifers were selected for mating. They consisted of 27 animals that had been used

9 months previously in the silage feeding experiment described by Morris (1958*b*) and 7 heifers that had not been used previously for experimental work. These two groups were approximately 30 and 20 months of age respectively when mating commenced. Prior to the commencement of mating they had been grazing predominantly *Paspalum dilatatum* pastures. All animals were negative to the serological tests for brucellosis and *Leptospira pomona* prior to mating and also at the commencement of the experiment.

The heifers were hand-mated to a Hereford bull during a period of 48 days. Three heifers returned to service and were re-mated; all others had been allowed one service only. The animals remained on paspalum pasture during the mating period and until one week before the commencement of the experimental treatments.

Two weeks before the experiment was due to commence the animals were examined for pregnancy. From the 32 found to be pregnant, 30 were selected for the experiment. These included 6 of the heifers that had not been used previously for experimental work.

The mean stage of gestation at the commencement of the experiment was 175 days. The mean body-weight gain of all animals from mating to the commencement of the experiment was 169 lb. The animals were in good condition.

To avoid confusion the term "heifers" has been retained throughout this paper, even though after calving, "cows" is more appropriate.

(iii) *Experimental Yards and Facilities*.—The yards and facilities were essentially those described by Morris (1958*a*). A duplicate set of three yards was provided with covered creeps so that the calves only could be supplemented after they had reached four weeks of age.

(iv) *Body-weight*.—The heifers and calves after they were 7 days of age were individually weighed on a cattle-weighing scale with an acuracy of ± 1 lb. The birth weights and 7-day body-weights of the calves were obtained on a weighbridge with an accuracy of ± 0·5 lb.

(v) *Sampling of Silage*.—Silage was removed by a post-hole auger from three sites in the trench before commencement of feeding. A subsample of this silage was used for quality tests and proximate analysis.

A sample for dry-matter determinations was also obtained from the silage fed each day. These oven-dried silage samples were retained and at the conclusion of the experiment subsampled for proximate analysis. As daily residues were not fed back during the last 13 weeks, they were sampled for dry-matter determinations. These dried samples of residues were retained and subsampled at the end of the experiment for proximate analysis.

(vi) *Methods of Chemical Analysis*.—Analytical methods employed were as follows:—proximate analyses of feedstuffs, Association of Official Agricultural Chemists (1955); silage quality tests, Watson and Ferguson (1937); serum protein, albumin and globulin, Gornall, Bardawill, and David (1949); plasma chloride, sodium and potassium, as described by Morris (1958*c*). Heparinized blood was used for the determination of haemoglobin by the method of Donaldson *et al.* (1951) and packed cell volume (P.C.V.) by essentially the method of Wintrobe (1947). A relative centrifugal force of approximately 2067 *g* was used for obtaining P.C.V.

(vii) *Determination of Milk Production.*—All heifers were segregated from their calves and hand-milked on the last day of the experiment. They were then milked again, in the same group order, 24 hr later. An intravenous injection of 10 I.U. of oxytocin in 10 ml of physiological saline was given to each cow immediately prior to each milking. The volume of milk obtained at the second milking was measured in a graduated measuring cylinder to an accuracy of $\pm$ 5 ml.

III. EXPERIMENTAL

(i) *Treatments.*—The 30 pregnant heifers selected for the experiment were confined to the experimental yards for a week immediately prior to the experiment and fed sorghum silage *ad lib.* They were then allotted to three groups of 10 by stratified random allocation on the basis of previous experimental treatment and mating date. The groups were allocated at random to the following experimental treatments:—

Group I: Sorghum silage *ad lib.*

Group II: Sorghum silage *ad lib.* + 1·5 oz urea and 0·14 oz sodium sulphate per head per day.

Group III: Sorghum silage *ad lib.* + 2·5 oz urea and 0·18 oz sodium sulphate per head per day.

The amount of silage fed daily was slightly in excess of intake. For the first 11 weeks of the experiment residues were fed back, the previous day's residue being placed on top of the freshly added silage. For the remaining 13 weeks the residues were weighed, sampled to obtain dry-matter content, and the remainder discarded. The change was made because it was considered that the presence of the previous day's residue may have been affecting voluntary silage intake. This change did not appear to result in increased consumption. The mixed urea and sodium sulphate supplement was sprinkled on the silage in the troughs and then mixed with the upper portion of the silage.

Heifers were removed from the experiment if their calves were born dead or died during the experimental period. This ensured that all animals in the experiment were either pregnant or suckling their calves.

On the first weekly weighing day after calves reached 4 weeks of age they, together with their dams, were transferred, in their respective groups, to the yards containing a creep. The calves were allowed unrestricted access to a mixture of equal parts by weight of lucerne chaff and crushed sorghum grain.

(ii) *Observations and Recordings.*—For the first 11 weeks of silage feeding, the mean daily dry-matter intake was computed from the weekly silage consumption and the average weekly dry-matter content. Thereafter, when residues were discarded, silage intake was measured daily and daily dry-matter intake calculated from determinations of dry-matter made on the silage as fed and on the residues.

Individual body-weights of the heifers were obtained weekly by weighing at a standard time (7 a.m.-8 a.m.). As the calving period approached all animals were weighed three times weekly and again on the morning of the day after calving. This allowed the pre-calving body-weight to be obtained 0–96 hr prior to parturition and the post-calving weight to be taken 0-24 hr after parturition.

The birth weight of calves was obtained between 6 and 16 hr after birth. Calves born in the morning were weighed in the afternoon and those born during the late afternoon and night were weighed between 7 a.m. and 8 a.m. on the next day. All live calves had dry coats at the time of weighing. Calves were weighed at the same time 7 days later, but thereafter were weighed on the standard weekly weighing days.

On the day prior to the commencement of silage feeding (initial) and at the beginning of the 24th week (final), heifers were bled for determinations of total serum protein, albumin and globulin; and plasma chloride, sodium and potassium. At the final bleeding analyses for haemoglobin and packed cell volume (P.C.V.) were also included. In addition, all calves were bled at this time and samples analysed for the same constitutents as those determined in the blood of their dams.

Daily observations were made on the general behaviour of the animals. Heifers calving during the daylight hours were observed. Animals showing manifest difficulty at calving were manually assisted and have been recorded as dystokias. Those retaining their placenta for longer than 72 hr were recorded and treated.

(iii) *Duration of the Experiment.*—The experimental treatment began on February 24, 1959, and continued for a period of 24 weeks. At this time the calves were weaned and kept in the yards for studies on early weaning. After determination of milk production the heifers were turned out to graze on *Paspalum dilatatum* pastures of adequate bulk but of poor quality.

IV. RESULTS

(i) *Silage Quality.*—In Table 1 the proximate analyses of a sample of silage without preparatory drying, a composite sample of silage resulting from bulking samples used for daily dry-matter determinations, and composite samples of silage fed and residues obtained from the three groups during the last 13 weeks are presented.

These analyses indicate that when the residues were not fed back the animals tended to select a ration lower in crude fibre and, in the case of Group I, higher in crude protein than that of the total feed presented. The higher protein (N x 6·25) in the residues for Groups II and III would suggest that all the urea was not being ingested.

The results of silage quality tests on the wet silage were as follows: dry-matter, 20·5 per cent.; pH, 3·6; lactic acid, 0·45 per cent.; and acetic acid, 0·57 per cent.

TABLE 1

PROXIMATE ANALYSES OF SAMPLES OF SORGHUM SILAGE AND RESIDUES

Sample	Moisture (%)	Crude Protein (%)	Ether Extract (%)	Crude Fibre (%)	Nitrogen-free Extract (%)	Ash (%)	Ca (%)	P (%)
Single*—As taken	79·5	0·9	0·5	7·0	10·7	1·4	0·07	0·01
D.M. basis†	..	4·3	2·2	34·1	52·4	7·0	0·35	0·05
Composite—D.M. basis	..	4·2	1·2	37·7	49·6	7·3	0·25	0·11
Composite‡ (July–August) (D.M.)	..	3·8	1·5	38·8	48·8	7·1	0·34	0·08
Residue—Group I (D.M.)	..	3·5	0·9	45·0	44·4	6·2	0·21	0·05
Residue—Group II (D.M.)	..	5·2	2·2	42·9	42·9	6·8	0·29	0·08
Residue—Group III (D.M.)	..	6·1	2·4	44·9	40·4	6·2	0·28	0·06

* Subsample from three sites in trench obtained prior to commencement of feeding.

† Corrected for loss of volatile material in drying.

‡ Composite (July-August) represents sample collected from silage fed during the period when residues were discarded after sampling.

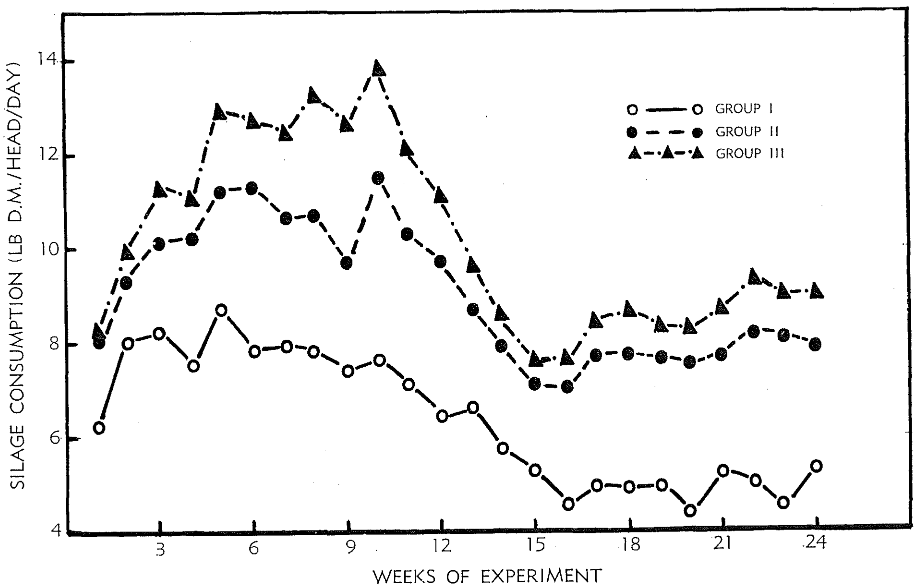

Fig. 1.—Weekly group mean sorghum silage consumption of heifers. Group I: Silage *ad lib.* Group II: Silage *ad lib.* + 1·5 oz. urea and 0·14 oz sodium sulphate per head per day. Group III: Silage *ad lib.* + 2·5 oz urea and 0·18 oz sodium sulphate per head per day.

The yellowish silage did not develop an unpleasant odour on exposure to air. Although there was only a moderate level of lactic acid, the appearance and low pH indicate a fair quality silage.

(ii) *Silage Consumption.*—The mean silage consumption per head per day on a dry-matter basis for each group calculated at weekly intervals is shown in Figure 1. Silage consumption in all groups showed a gradual decline from the 10th to the 16th week of feeding. Thereafter, the intake remained relatively constant in Group I, but increased slightly in Groups II and III.

The average daily dry-matter consumption for Groups I, II and III was 6·3, 9·0 and 10·2 lb per head respectively.

(iii) *Survival of Heifers.*—All heifers survived the silage feeding period, but two of the animals in Group I were weak and became prostrate within two weeks of being turned out to graze. One pregnant heifer was removed from Group I after 12 weeks of feeding because it showed symptoms resembling *otitis media.* Two heifers from Group II that had been in the experiment for 23 and 74 days aborted after 205 and 246 days' pregnancy respectively. The cause of the abortions could not be determined. Bacteriological examinations of both foetuses were negative for *Brucella abortus, Leptospira pomona, L. hyos, Vibrio fetus* and *Trichomonas foetus.*

(iv) *Body-weight of Heifers.*—The number of heifers calving at term, their mean initial body-weight, their body-weight loss prior to calving, and the mean period of silage feeding prior to calving are shown in Table 2. Group I lost significantly more weight than Groups II and III ($P < 0{\cdot}001$) and Group II lost significantly more weight than Group III ($P < 0 \cdot 05$). There were no significant correlations between body-weight loss and initial body-weight, date of calving or birth weight of the calf.

TABLE 2

Mean Period on Experiment of Heifers Calving at Term and Mean Body-weight Changes Prior to Calving

Group	No. of Heifers Calving at Term	Mean Period on Experiment Prior to Calving (days)	Mean Body-weight (lb)	
			Initial	Loss Prior to Calving
I	9*	107 ± 4	842	150 ± 10
II	8†	108 ± 5	818	79 ± 11
III	10	106 ± 4	845	42 ± 10

* One cow removed from Group I with symptoms resembling *otitis media.*

† Two cows from Group II aborted after 205 and 246 days' pregnancy respectively.

The mean weight loss in heifers at calving, as determined by weighing within 96 hr prior to parturition and within 24 hr after calving, were: Group I, 74 ± 8 lb; Group II, 84 ± 8 lb; and Group III, 102 ± 8 lb. Group III lost significantly more weight at calving than Groups I and II ($P < 0 \cdot 05$), while Group II lost significantly more weight than Group I ($P < 0 \cdot 05$). The weight loss at calving expressed as a percentage of weight before calving was 10·6, 11·1 and 12·6 per cent. for Groups I, II and III respectively. The birth weight of the calf accounted for 65·8, 60·1 and 54·7 per cent. of this weight loss in Groups I, II and III respectively. These differences were not significant.

The number of heifers lactating at the end of silage feeding, their mean body-weights at commencement of silage feeding, within 24 hr post-calving, and at the end of silage feeding, together with the mean body-weight loss during lactation and during the period of silage feeding, are shown in Table 3. The reduced number of heifers at this period in relation to the number of heifers calving at term is due to animals being removed from the experiment because they either had stillborn calves or because their calves had died.

TABLE 3

Mean Body-weight Changes of Heifers Lactating at the End of Silage Feeding

Group	No. of Lactating Heifers	Mean Stage of Lactation at Final Weighing (days)	Mean Body-weight (lb)				
			Initial	Post-calving*	Final	Loss During Lactation	Loss During Experimental Period
I	6	63 ± 2	865	634	480	154 ± 10	385 ± 17
II	7	64 ± 3	823	662	537	125 ± 10	286 ± 15
III	7	60 ± 4	850	716	614	102 ± 10	236 ± 15

* Body-weight post-calving was obtained within 24 hr after calving.

During lactation, Group I lost significantly more weight than Groups II and III ($P < 0 \cdot 01$) and Group II lost significantly more weight than Group III ($P < 0 \cdot 01$). During the whole silage feeding period, Group I lost significantly more weight than Group II ($P < 0 \cdot 01$) and Group III ($P < 0 \cdot 001$). Group II lost significantly more weight than Group III ($P < 0 \cdot 05$).

(v) *Calving Data.*—The mean gestation period, incidence of dystokia and retained placenta in the heifers calving at term, and the sex ratio and mean birth weights of the calves, are shown in Table 4. There was no significant difference between groups in gestation length. The overall incidence of both dystokia and retained placenta was 4 of 27 heifers calving at term, with no significant differences between groups. The cases of retained placenta were all in cows not requiring assistance at calving.

TABLE 4

Gestation Period and Incidence of Dystokia and Retained Placenta in the Heifers, and Mean Birth Weight and Sex Ratio of the Calves

Group	No. of Heifers Calving at Term	Gestation Period (days)	Mean Birth Weight of Calves (lb)	Sex Ratio Male : Female	Dystokia	Retained Placenta
I	9	280·0 ± 1·9	48·4 ± 2·3	5 : 4	1	3
I	8	283·1 ± 2·0	50·2 ± 2·4	4 : 4	1	1
III	10	282·4 ± 1·8	55·6 ± 2·2	4 : 6	2	0

The calves from Group III had significantly higher birth weights than those from Group I ($P < 0 \cdot 05$). Male calves in all groups were on the average $4 \cdot 7 \pm 2 \cdot 7$ lb heavier at birth than females but this difference was not significant.

(vi) *Mortality of Calves.*—The number of calves born at term, those stillborn and those dying during the period of silage feeding are shown in Table 5. The age of death of calves failing to survive is also shown.

TABLE 5

Mortality of Calves During Experimental Period

Group	No. of Calves			Age at Death (days)
	Born at Term	Stillborn	Dying During Experimental Period	
I	9	0	4	7, 23, 54, 65
II	8	1	0	. .
III	10	1	2	2*, 13

* This calf was destroyed due to deformity of the left forelimb.

The deaths of four calves in Group I were all considered to be due to the experimental treatment. Two of the calves died after creep feed was made available, one dying on the last day of the experiment. No milk was found in the abomasum of any of the calves at autopsy. Bacteriological examination of the internal organs and examination for internal parasites were negative in all cases. The one stillborn calf in each of Groups II and III was associated with a dystokia. No deaths occurred after birth in calves from Group II. In Group III, one live calf had a contracted flexor tendon in the left front leg and stood on the anterior aspect of the metacarpo-phalangeal joint. It was unable to move sufficiently to suckle and was destroyed at 2 days of age. The other calf that died in Group III was from a dam that required assistance at calving, had a birth weight of 48 lb and was weak at birth. It developed whitish, blood-stained scours at 6 days of age, gradually became weaker, and died at 13 days of age. The faeces was negative for *Salmonella* spp. and no common bacterial pathogens were found at autopsy.

(vii) *Growth Rate of Calves.*—The weight gains of calves surviving from birth to 7 days of age and of those surviving from birth to 28 days of age are shown in Table 6. These calves had access to their dams' milk and to the sorghum silage being fed to the heifers. There were no significant differences between groups at 7 days, but the difference between the means of Group I and II was significant ($P < 0 \cdot 05$) at 28 days.

TABLE 6

MEAN BODY-WEIGHT GAIN OF CALVES FROM BIRTH TO 7 DAYS AND BIRTH TO 28 DAYS

Group	Body-weight Gain (lb)	
	Birth to 7 days	Birth to 28 days*
I	$2 \cdot 7 \pm 1 \cdot 5$	$9 \cdot 4 \pm 2 \cdot 8$
II	$6 \cdot 9 \pm 1 \cdot 6$	$23 \cdot 3 \pm 2 \cdot 8$
III	$3 \cdot 9 \pm 1 \cdot 5$	$16 \cdot 4 \pm 2 \cdot 8$

* The regression coefficient of weight gain to 28 days on calving date was significant and means have been adjusted.

(viii) *Milk Production.*—For each group, the mean stage of lactation and the mean of the milk production for a 24-hr period at the completion of 24 weeks of silage feeding, together with standard errors, are shown below:

Group	Mean Stage of Lactation (days)	Mean Milk Production (ml)
I	63 ± 2	485 ± 169
II	64 ± 3	1251 ± 157
III	60 ± 4	1062 ± 157

Groups II and III produced significantly more milk ($P < 0 \cdot 05$) than Group I. There was no significant correlation between milk production and either date of calving or birth weight of the calf.

TABLE 7

GROUP MEANS FOR BLOOD AND SERUM ANALYSES OF CATTLE FED SORGHUM SILAGE AND SORGHUM SILAGE PLUS TWO LEVELS OF UREA

Determination	Group I		Group II		Group III	
	Initial	Final	Initial	Final	Initial	Final
Total serum protein (g/100 ml) ..	7·8	6·9 ± 0·3*	7·9	6·5 ± 0·3**	8·1	6·9 ± 0·3**
Serum albumin (g/100 ml)	3·7	3·2 ± 0·1*	3·7	3·3 ± 0·1	3·8	3·5 ± 0·1
Serum globulin (g/100 ml)	4·1	3·7 ± 0·4	4·2	3·1 ± 0·3*	4·3	3·4 ± 0·3*
Plasma chloride (m–equiv./l)	108·2	106·2 ± 0·8	112·9	104·1 ± 0·7***	110·5	104·1 ± 0·7**
Plasma sodium (m–equiv./l)	141·6	135·1 ± 1·6**	142·5	136·5 ± 1·5**	144·9	136·9 ± 1·5**
Plasma potassium (m–equiv./l) ..	4·8	4·8 ± 0·3	4·8	4·3 ± 0·3	5·5	5·0 ± 0·3
Blood haemoglobin (g/100 ml) ..	..	11·2 ± 0·7	..	11·6 ± 0·6	..	13·1 ± 0·6
P.C.V. (%)	..	33·3 ± 2·2	..	35·2 ± 2·1	..	38·9 ± 2·1

*, **, ***—Final value significantly higher (or lower) than initial value at 5%, 1% and 0·1% levels respectively.

(ix) *Biochemical Values*.—The initial and final values for serum total protein, albumin and globulin; and plasma chloride, sodium and potassium on samples obtained from the heifers are shown in Table 7. Final values for haemoglobin and P.C.V. are also included in Table 7. There were no significant differences among group final means. Final values for serum total protein and plasma sodium showed a significant decline from initial values in all groups. There was a similar result for plasma chloride in Groups II and III.

The values for serum total protein, albumin and globulin; plasma chloride, sodium and potassium; haemoglobin and P.C.V. on blood samples obtained from the calves during the last week of silage feeding are shown in Table 8. Calves from heifers in Group II showed significantly higher mean haemoglobin ($P < 0 \cdot 05$) and P.C.V. ($P < 0 \cdot 01$) levels than calves from Groups I and III. The mean plasma sodium level for Group III calves was significantly higher than those for calves from Groups I and II. No other differences were significant.

TABLE 8

Group Means and Standard Error for Blood and Serum Analyses of Calves from Heifers Fed Sorghum Silage and Sorghum Silage Plus Two Levels of Urea

Determination	Group I	Group II	Group III
Total serum protein (g/100 ml) ..	5·7 ± 0·2	6·2 ± 0·2	5·9 ± 0·2
Serum albumin (g/100 ml) ..	3·5 ± 0·1	3·6 ± 0·1	3·4 ± 0·1
Serum globulin (g/100 ml) ..	2·2 ± 0·2	2·6 ± 0·2	2·5 ± 0·2
Plasma chloride (m-equiv./l) ..	105·5 ± 1·1	103·1 ± 1·0	102·5 ± 1·0
Plasma sodium (m-equiv./l) ..	134·6 ± 1·2	134·6 ± 1·1	139·4 ± 1·1
Plasma potassium (m-equiv./l) ..	5·1 ± 0·2	5·3 ± 0·2	5·4 ± 0·2
Blood haemoglobin (g/100 ml) ..	12·0 ± 0·5	13·5 ± 0·4	11·8 ± 0·4
P.C.V. (%)	37·7 ± 1·5	46·5 ± 1·4	37·0 ± 1·4

V. DISCUSSION

This experiment was designed to evaluate sorghum silage as a survival fodder for cattle during late pregnancy and early lactation. The silage was comparable in chemical composition with the product made from sorghum grown in the low-rainfall areas of western Queensland.

The experiment was conducted in bare yards under simulated drought feeding conditions. Animals were fed for 24 weeks, commencing 106-108 days (group means) prior to calving and terminating 60-64 days (group means) after calving.

The findings indicated that silage of the quality used, when fed as the sole ration, resulted in marked weight losses in heifers prior to calving and low birth weights and poor survival of calves. Some of the heifers were very weak at the conclusion of feeding. The supplementation of the silage with non-protein nitrogen in the form of urea, at levels of 1·5 oz and 2·5 oz per head per day, resulted in increased silage consumption, reduced weight losses in the heifers and markedly lower calf mortality.

The daily addition of 1·5 oz and 2·5 oz urea per head increased the consumption of silage by 43 and 62 per cent. respectively. This is in agreement with the findings of Morris (1958*b*) for maiden heifers fed sorghum silage and supplemented with the same amounts of urea.

The gradual decline in silage consumption in all groups from the 10th to the 16th week could be due to a number of factors. Firstly, it could be associated with the loss in body-weight of the animals. Morris (1958*b*) recorded a gradual increase in intake of silage in the groups of maiden heifers showing a gain in body-weight and a gradually decreasing intake in the group declining in body-weight. Secondly, the quality and palatability of the silage could have varied with the location in the trench. The lower crude protein content of the composite sample obtained during the last 13 weeks when compared with that collected during the whole experimental period would indicate that the chemical composition was variable. As a response in intake was obtained with the addition of nitrogen to this silage, it could be expected that any decrease in the crude protein content of the basal silage would result in a reduced intake. Thirdly, it has been postulated by Mäkelä (1956), cited by Blaxter (1957), that the space occupied by the developing foetus in the abdominal cavity could be a factor in reducing intake of bulky feeds. Some support for this hypothesis is evident because the major decline commenced approximately 3 weeks before the first cow calved and continued until the groups contained a number of lactating animals. Intake increased slightly after most of the heifers had calved. However, all intakes were low and this, together with the fact that the group on the lower intake also declined but at a slightly slower rate, would suggest that this was not the only factor operating.

The supplement of urea resulted in a significantly reduced weight loss in the heifers. However, at the levels fed, it did not permit the maintenance of body-weight in the pregnant heifers, despite the increasing contribution of the foetus, foetal membranes and fluids to the recorded weight.

Nutritive requirements increase in the last third of pregnancy, since approximately two-thirds of the foetal growth occurs during this period (Winters, Green, and Comstock 1942). If nutrition plays a part in the birth weight of calves, then the plane of nutrition in the later stages of pregnancy is likely to be the more important. In this experiment the mean weight losses in heifers in the last 106-108 days of pregnancy (group means) were 1·4 lb per head per day for the group receiving silage alone and 0·7 lb and 0·4 lb per head per day for the groups receiving in addition a daily supplement of 1·5 oz and 2·5 oz of urea per head respectively. The mean birth weight of the calves from the unsupplemented group was significantly lower than that of calves from the group receiving the higher level of urea supplementation. This is in agreement with the findings of Wallace (1948) for sheep. It is also in agreement with the conclusion made by Blaxter (1957), on the basis of published work, that birth weight in cattle reflects maternal nutrition. Joubert and Bonsma (1957), comparing "high" and "low" planes of nutrition, in which heifers showed weight changes of + 173·8 lb and — 28·2 lb respectively from conception to weight pre-partum, obtained no significant differences in birth weights of calves. They concluded that it was possible for a heifer to produce a calf of normal weight at birth without her gaining any weight at all during pregnancy provided she had reached 70-80 per cent. of her ultimate mature weight prior to pregnancy. In the experiment reported in the present paper, all groups actually showed a gain between mating and pre-partum weight, but this represented a mean gain of approximately 1 lb per head per day in the first 6 months of pregnancy and a variable weight loss in the last third of pregnancy. The actual stage when nutritional stress occurs and its severity are likely to be important factors in determining birth weight of calves.

Under the conditions of this experiment, it was not possible to assess accurately the weight loss of heifers at calving. The data obtained by the method used, viz. weighing the dam within 96 hr prior to calving and within 24 hr after calving, are in agreement with the findings of Eckles and Swett (1918) and Joubert and Bonsma (1957), who found a lower weight loss at calving in "low" plane heifers compared with "high" plane heifers.

In simulated drought feeding experiments of this nature, where the energy expenditure of the heifers in obtaining feed was minimized by confinement in yards, it would appear on the limited data available that the calf would die from malnutrition before the dam succumbed. Reliable field data for grazing cows and their calves during drought are not available.

The milk production, as assessed by milk obtained over a period of 24 hr at group mean lactation periods of 60–64 days, was significantly higher in the two groups receiving urea. This was reflected in the higher mean weight gains during the first 28 days of the calves suckling heifers in the two supplemented groups. However, the weight advantage was significant only in the group receiving the lower level of urea.

The milk production of the cows and the growth rate of calves from the group receiving the lower level of urea were higher, but not significantly different from those receiving the higher level of urea. It is possible that the potentially higher milk producers were allotted to the former group when they were randomized on the basis of mating date.

The method used for the assessment of milk production must be regarded only as comparative. There is evidence (J. W. Ryley and R. J. W. Gartner, to be published) that even with milk yields of this order, the amount obtained after a 24-hr milking interval is much less than the 24-hr yield calculated from a 4-hr milking interval. Also, the amount actually obtained by the calf may vary from that obtained by hand-milking.

Morris (1958*b*) reported that maiden heifers fed sorghum silage supplemented with 1·5 oz or 2·5 oz of urea per head per day for 28 weeks had significantly higher total plasma protein concentrations than those fed sorghum silage alone. In this experiment with lactating animals, there was no significant difference in serum protein concentration between groups at the conclusion of the feeding, although all groups showed values significantly lower than initial levels.

These values for the group receiving silage alone were higher than those obtained by Morris (1958*b*). Only one animal from the group fed solely on sorghum silage showed any visible evidence of oedema of the submaxillary space, whereas a high incidence was recorded by Morris (1958*b*) in the comparably fed group of maiden heifers.

Although final values were significantly lower than initial levels for plasma sodium in all groups and for plasma chloride in the two groups receiving urea, the final levels could not be regarded as pathological. The biochemical values on blood and serum from the calves are comparable with those obtained in Hereford calves, of similar age, suckling dams grazing the predominantly *Paspalum dilatatum* pastures at the Animal Husbandry Research Farm, Rocklea (unpublished data). The higher haemoglobin concentration and P.C.V. in the calves suckling animals receiving a supplement of 1·5 oz urea per head per day are consistent with the better growth shown by these calves.

The results of this experiment were obtained with heifers initially in forward condition and gaining approximately 1 lb per head per day during the first two-thirds of pregnancy. Graziers would be unlikely to contemplate feeding for survival until cattle were in much poorer condition. It is therefore evident that sorghum silage stored with a view to feeding pregnant or lactating cattle during drought should be either of better food value than that used in this experiment or be fed with supplements. From this experiment it is evident that such supplements should be high in nitrogen. The provision of a sorghum silage of higher protein content would necessitate either conservation at a younger stage of growth, or the conservation of mixtures of sorghum and a leguminous plant.

VI. ACKNOWLEDGEMENTS

The author wishes to acknowledge indebtedness to the following officers of the Queensland Department of Agriculture and Stock: officers of the Biochemical Branch, in particular Mr. R. J. W. Gartner, for chemical analyses; Mr. A. W. Beattie and Miss D. E. Nunn for statistical analyses; Mr. J. W. Watson, for pregnancy examinations; Mr. M. J. Radel for care and feeding of experimental animals; and Miss K. Scheldt and Mr. W. B. Hornbuckle for technical assistance.

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(Received for publication August 21, 1961)