BABY BEEF WITHOUT CONCENTRATES — A FEASIBILITY STUDY

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SUMMARY

The use of single- or double-suckled autumn calving Friesian cows to produce calves of 350 to 400 lb carcass weight at 12 months of age off pasture was investigated over two years. Initial stocking rates were either 6 single-suckled, or 4 double-suckled cows on 6 acres.

Meat production of the above order was achieved, but the stocking rate of one single-suckled cow and calf per acre appeared to be too high for this management system. One single-suckled cow and calf were removed from the area during the second winter. Net outputs of 348 lb and 434 lb of beef carcass/acre/annum were obtained under single- and double-suckling, respectively. The most difficult management problem encountered was a delay of 5 to 9 weeks in getting the cows in calf.

The carcasses of the calves showed satisfactory development and distribution of lean meat. The palatability characteristics of the meat, as judged by a trained taste panel and shear force measurements, differed little from those of conventionally produced Aberdeen Angus cattle.

THE PRODUCTION of beef from 12- to 15-month-old animals is usually considered to have the advantages over producing beef from stock aged 20 to 30 months of a more rapid turnover of capital, higher food conversion efficiencies from the use of young, fast growing animals, and the production of very tender meat from carcasses with a low fat content. Under European conditions the economic viability of the system appears to fluctuate with variation in grain prices and purchase costs of suitable calves.

By international standards, the prices of calves in New Zealand are low, but the high costs of grain relative to the returns for beef have prevented the development of a local baby beef industry. A system of baby beef production based on the utilization of pasture was the objective of the present study. It is accepted that the use of first-class land for the production of baby beef could only be justified on a national as opposed to an individual farmer basis, if it could be shown that high per-acre yields of high priced meat could be obtained at low cost from a self-contained management system.

The system proposed was based on the autumn calving of Friesian cows. Calves were suckled throughout the

winter, weaned in the spring and slaughtered in late summer or early autumn when calf growth rates were declining. It was envisaged that the high milk yields of Friesian cows would maintain rapid calf growth rates during winter, and the spring flush of grass would enable these to be maintained after weaning. Thus a continuous rapid growth rate for the calves would be maintained from birth to slaughter.

A pilot trial was initiated in 1966 to investigate the feasibility of this system, and to obtain limited information on the following questions:

(1) What order of meat outputs per acre could be expected from these systems?

(2) Was double-suckling a reasonable alternative to single-suckling in this system?

(3) What yields of salable meat would be obtained from the carcasses and how would this meat be distributed within the carcass?

(4) Is the palatability of the meat produced sufficiently high to encourage this special-purpose type of meat production?

(5) What are the management problems involved? Can the calves deal with all the milk available? Conversely, can the cows milk adequately throughout the winter on limited quantities of hay and silage and not suffer from metabolic diseases?

EXPERIMENTAL

Two similar 6 acre areas were obtained by halving three 4 acre paddocks and randomizing the resulting 2 acre plots between single- and double-suckling treatments. Initially six single-suckled mature Friesian cows were maintained on one 6 acre area and four similar double-suckled cows on the other. The stocking rate of the single-suckled group was reduced during June of the second winter by the removal of one cow and calf.

The cows calved between January 16 and April 7 in 1966. Prior to this, 4 acres of spring silage and a further 4 acres of late hay had been conserved from within the 12 acre experimental area. The available forage was equally divided between the two groups. The silage was fed in one paddock for 50 days from May 18. Thereafter they grazed autumn-saved pasture with a supplement of hay being fed for 35 to 43 days from August 14. In the second year,

one crop of early hay was taken from 2 acres within each suckling treatment area and the trial was then shifted to a new site. A further 2 acres of late hay was conserved on this new area. Hay was fed in conjunction with autumn-saved pasture from April 20 to September 21.

Calves were purchased from local farmers for fostering on to double-suckled cows. The sex ratio of the calves varied between years and suckling systems; bull calves were left entire. Weaning took place on October 19 in 1966 and November 20 in 1967 giving average weaning ages of 36 and 37 weeks, respectively. After weaning, the cows were restricted in intake by being confined to a limited area, or by being used to clean up roughage after the calves.

Cows were mated in both years by artificial insemination. Entire bulls were used as an aid in the detection of oestrus in 1966, but not in 1967. All stock were weighed fortnightly and the cows were sampled at weighing for blood serum magnesium, calcium and ketone levels. Similarly treated replacement cattle were run on an adjacent area. One single-suckled cow failed to get in-calf in 1966, and another had a calving interval of 508 days. Both were replaced.

Calves were fasted 48 hr prior to slaughter, hung at 4 to 7° C for 24 hr, and then separated into commercial boneless fat trimmed meat cuts (Everitt, 1961). From the carcasses of the 1966 calves three commercial rump *(m. gluteus medius)* and three commercial blade *(m. infraspinatus)* steaks were removed from each, wrapped in polythene and stored at −7° C. Two steaks from each site were used for laboratory taste panel assessments of aroma, flavour fullness and acceptability, tenderness and juiciness (Woodhams and Trower, 1965; Marsh *et al.*, 1966) and the third for objective measurements of toughness using a "tenderometer" (Macfarlane and Marer, 1966). To provide comparative data, steaks were also obtained from the same sites on carcasses of 20-month-old Aberdeen Angus cattle which had been fattened at 2 beasts per acre and subjected to the same slaughter procedures.

RESULTS AND DISCUSSION

Table 1 and Fig. 1 provide data on growth of the calves. The average growth rates were high, particularly with the single-suckled group, whose performance of rapid and uninterrupted growth approached that of concentrate-fed calves overseas (Buysse *et al.*, 1966; Forbes *et al.*, 1966; Preston *et al.*, 1963a, b). With the double-suckled calves, a

TABLE 1: CALF LIVEWEIGHT DATA

Suckling	Year	Slaughter Liveweight (lb) Range	Mean	Age (wks)	Av. Daily Gain (lb/day)
Single	1966-7	670-1,020	823	53	2.0
	1967-8	602-1,044	756	48	2.0
Double	1966-7	675-910	782	57	1.7
	1967-8	565-752	664	50	1.7

TABLE 2: NET BEEF PRODUCTION PER ACRE (lb) FROM CALVES

Suckling	1966-7	1967-8	Av. Prodn/Annum
Single	369	341	348
Double	456	436	434

TABLE 3: LIVEWEIGHTS OF COWS (lb)

Suckling	Year	Period 9/3-10/4	29/6-31/7	3/1-29/2	Whole Year	Post-Calving Wt Change
Single	1966-7	1,170	1,010	1,245	1,140	
	1967-8	1,110	995	1,110	1,040	— 75
Double	1966-7	1,010	910	1,150	1,020	
	1967-8	1,040	960	1,100	1,000	+ 45

TABLE 4: BLOOD SERUM MAGNESIUM LEVELS OF COWS (mg/100 ml)

Suckling	Year	Period 26/1-31/3	6/4-5/6	15/6-14/8	24/8-23/10	2/11-15/1	Whole year
Single	1966-7	2.57	2.17	1.47	1.86	1.73	1.97
	1967-8	2.04	1.67	1.16	1.37	1.77	1.65
Double	1966-7	2.66	2.43	1.55	2.06	2.06	2.15
	1967-8	2.52	1.88	1.36	1.81	1.94	1.94

TABLE 5: LEVELS OF SUPPLEMENTARY FEEDING (lb DM)

Suckling	Year	Total	Days	DM/cow/day
Single	1966	9,596	88	18.2
	1967	8,139	155	9.7
Double	1966	8,359	104	20.1
	1967	11,738	151	19.4

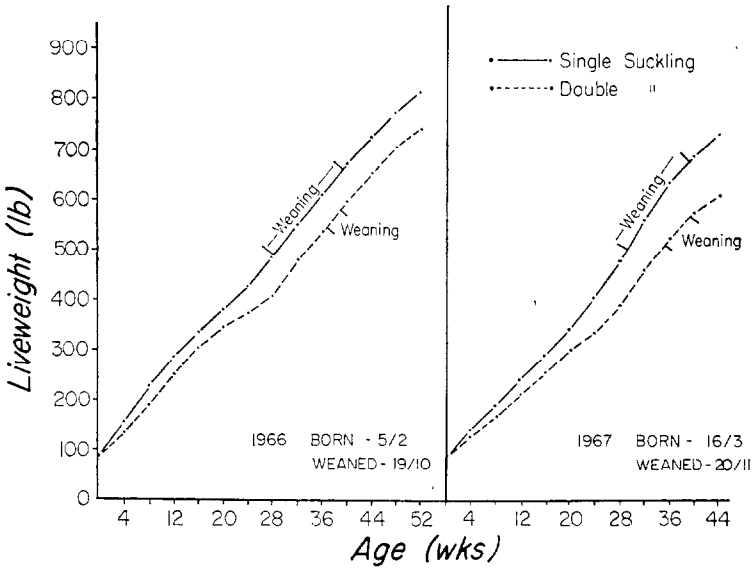

FIG. 1: *Growth rate of calves.*

relatively smooth growth curve was obtained in 1967, but a marked winter growth rate check occured in 1966. The final liveweight of the animals was very variable. Some of this variation arose from the differences in sex and age within the suckling groups, but the differences in individual animal performance were high enough to suggest some scope for selection of stock for this type of production. It was noteworthy that two of the three single-suckled bulls in the trial reached 1,000 lb by 12 months of age.

The net outputs of beef per acre (Table 2) were high, particularly from the double-suckled group, considering the biological inefficiencies of carrying suckling cattle on fattening land. These arose, not only from the double conversion of grass to milk and milk to liveweight gain, but also from the need to carry dry cows on the area for 15 to 16 weeks. Further, there would have been high conservation losses associated with the practice under this autumn-calving system, of cutting two-thirds of the available area each year for hay or silage.

The capacity of cows managed in this way to continue to produce at these levels over an extended period can be estimated from their liveweights (Table 3), their blood serum magnesium levels (Table 4) and the quantities of supplementary feed available (Table 5).

The declines in both liveweight and the amounts of magnesium in the blood serum of the single-suckled cows indicated that they were coming under increasing nutritional stress as the trial progressed. The weight and condition of these cattle led to the decision to reduce the stocking rate in 1967 and it is possible that a further reduction may have been required in subsequent years. This speculation is based on the decline in fodder supplies for this group between 1966 and 1967 (Table 5), and the 38% and 32% lower hay yields obtained from the single-suckled cows' paddocks compared with those grazed by the double-suckled group in 1966 and 1967, respectively. Thus it would appear that, under single-suckling at a cow and calf per acre, the stocking rate had been high enough to "break" the system, and an overgrazing and declining pasture production syndrome had developed. By contrast, the double-suckled group appeared to have every prospect of maintaining their levels of production over an extended period.

In making comparisons between these two production systems, it is important to remember that, not only did they differ in number of calves suckled, but also in effective stocking rates and in sex ratios of the calves. With this degree of confounding there can be no certainty as to which of these factors was responsible for the differences. However, as pasture appeared to be fully utilized under both systems, it would seem probable that sex ratio was a relatively minor cause of the differences observed.

Table 4 shows that both suckling groups were hypomagnesaemic (< 1.8 mg Mg/100 ml blood serum; Butler, 1963) during the winter, and that the single-suckled cows were hypomagnesaemic throughout most of the second year of the trial. Hemingway and Ritchie (1965) point out that this phenomenon of apparently normal production from hypomagnesaemic cattle has been widely reported. The contention of the latter authors that tetany occurs in association with hypocalcaemia was supported by the one case that occurred in this trial. This was a double-suckled animal in June, 1966 which had a low blood serum magnesium level (0.94 mg/100 ml) in association with a very low blood serum calcium level (6.55 mg/100 ml). Blood serum ketone levels were always less than 20 mg/100 ml and only rarely rose above 10 mg/100 ml.

A potentially more intractable management problem was the prolonged calving intervals of the cows between 1966 and 1967. The mean calving interval of the double-suckled group was 402 days (range, 387 to 426 days). The situation was worse in the single-suckled cows; one ani-

mal was barren and the remainder had a mean calving interval of 426 days (range, 376 to 508 days). Predictions of calving dates in 1968 from mating dates and pregnancy diagnoses suggested that calving intervals would have been still longer in the following year. Similar problems were experienced with the three surplus cows managed along similar lines. These observations are in general agreement with the finding of Saiduddin *et al.*, (1968) that suckling of dairy cattle extends the interval between parturition and first oestrus. In the present trial, the declining liveweights of the cows at mating and the use of artificial insemination could also have been factors contributing to the long calving intervals observed. As the success of this system of management for beef production is dependent on relatively precise timing of calving, it is obvious that further work on this problem of prolonged calving intervals is required.

Carcass weights relative to the method of rearing, and the cutting yields of the carcasses are given in Tables 6 and 7, respectively. The carcasses were considered to be satisfactory, although the proportions of fat trim were higher than had been expected in animals of this age finished off on summer pasture. The distribution of the meat within the carcass (Table 8) was also satisfactory, being closely comparable with Aberdeen Angus cattle intensively managed and slaughtered at 20 months.

TABLE 6: COLD CARCASS WEIGHTS (lb) AND DRESSING-OUT PERCENTAGES OF CALVES

Suckling	*Year*	*Carcass Wt*		*Dressing % of:*	
		Range	*Mean*	*Full Wt*	*Fasted Wt*
Single	1966-7	334-475	412	50.2	53.8
	1967-8	308-537	394	52.1	55.8
Double	1966-7	347-464	384	49.2	52.0
	1967-8	281-384	327	49.2	53.4

TABLE 7: PERCENTAGES OF CARCASS COMPONENTS

Sex	*Year*	*No.*	*Muscle*	*Bone*	*Fat*
Bull	1966-7	7	69.3	24.5	6.3
	1967-8	5	63.9	27.0	9.1
Heifer	1966-7	7	62.6	23.2	14.1
	1967-8	8	60.8	23.2	16.0

TABLE 8: MEAT DISTRIBUTION WITHIN CARCASSES
(% of side weight)

Price of Cuts	*Cuts*	*Friesian (12 mon)* *Bull*	*Heifer*	*A. Angus (20 mon) Heifer*
High	Fillet	1.6	1.8	1.6
	Cube roll + Loin	6.4	6.7	6.7
	Sirloin + Rump	6.3	5.9	5.9
	Total	14.3	14.4	14.2
Medium	Blade	6.4	5.8	5.8
	Knuckle + Inside + Outside	12.8	12.4	12.8
	Total	19.2	18.2	18.6
Low	Shin	4.8	4.9	3.4
	Brisket	7.8	7.4	8.1
	Chuck	10.3	8.2	10.6
	Total	22.9	20.5	22.1

Altogether, these findings show that carcasses satisfactory for both lean meat content and distribution were produced by these young animals. It is contended however, that this method of beef production remains relatively pointless unless the meat can be shown to have superior palatability characteristics. The results of the taste panel and tenderometer tests (Table 9) show that there was little difference between steaks from these animals and similar steaks from conventionally produced 20-month-old Aberdeen Angus steers and heifers.

TABLE 9: PALATABILITY CHARACTERISTICS* OF FRIESIAN (12 months) AND ABERDEEN ANGUS (20 months) CATTLE

Characteristic	*Breed*	*Bull (F) or Steer (AA)* *Blade*	*Rump*	*Mean*	*Heifer* *Blade*	*Rump*	*Mean*
Aroma	F	5.4	5.3	5.4	5.6	5.6	5.6
	AA	5.4	5.6	5.5	5.6	5.3	5.4
Flavour acceptability	F	5.6	5.2	5.4	5.5	5.5	5.5
	AA	5.8	5.4	5.6	5.9	5.5	5.7
Flavour fullness	F	5.2	5.3	5.3	5.9	5.6	5.7
	AA	5.7	5.5	5.6	5.4	5.6	5.5
Juiciness	F	5.9	5.5	5.7	5.8	4.8	5.3
	AA	5.3	5.0	5.2	5.9	5.4	5.7
Tenderness	F	5.9	5.3	5.6	6.2	5.8	6.0
	AA	5.3	5.9	5.6	6.2	6.0	6.1
Tenderometer values	F	31.0	27.3	29.2	27.0	32.2	29.6
	AA	22.1	23.0	22.5	24.1	27.1	25.6

*Taste panel scores 1-9 in ascending order of preference. Tenderometer values in seconds to shear point.

One reason for failure of these 12-month-old animals to produce carcasses with superior palatability characteristics could have been the use of entire bulls instead of steers. However, the scores obtained from the bulls were closely comparable with those of the Friesian heifers and the Aberdeen Angus steers and did not suggest that the use of bulls had had any marked effect on the results obtained.

A point of incidental interest was the very similar palatability characteristics of the rump and blade steaks, despite their wide differences in retail price. Ramsbottom and Strandine (1948) also found no difference in tenderness between muscles from these two sites.

CONCLUSIONS

The production features of this system of beef production appeared to be satisfactory in terms of output of carcass meat per acre, carcass weights and distribution of meat within the carcass. However, it is considered that the system does not merit widespread adoption at present, as serious problems could be anticipated in maintaining a 12-month calving interval. Further, the fact that the palatability characteristics of the meat were not superior to those of conventionally produced beef did not justify the adoption of this form of production in preference to normal weaner fattening systems, from which higher net outputs of beef/acre can be expected.

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REFERENCES

Butler, E. J., 1963: *J. agric. Sci. Camb., 60*: 329.

Buysse, F.; Boucque, C.; Eeckhout, W., 1966: *Govt. Res. Stat. Anim. Nutr., Gontrode (Ghent), Publ. No. 1,* 78 pp.

Everitt, G. C., 1961: *Bull. Inst. Meat, 31*: 2.

Forbes, T. J.; Raven, A. M.; Robinson, K. L., 1965: *Rec. Agric. Res., Min. Agric. Northern Ireland., 14* (1): 83.

Forbes, T. J.; Raven, A. M.; Robinson, K. L.; Irwin, J. H. D., 1966: *Rec. Agric. Res., Min. Agric., Northern Ireland 15* (2): 115.

Hemingway, R. G.; Ritchie, N. S., 1965: *Proc. Nutr. Soc., 54:* 63.
Macfarlane, P. G., Marer, J. M., 1966: *Fd Technol.* (Champaign) *20:* (6): 134.
Marsh, B. B.; Woodhams, Pamela R.; Leet, N. G., 1966: *J. Fd Sci., 31:* 262.
Preston, T. R.; Whitelaw, F. G.; Aitken, J. N.; Macdearmid, A.; Charleson, Euphemia B., 1963a: *Anim. Prod., 5:* 47.
Preston, T. R.; Aitken, J. N.; Whitelaw, F. G.; Macdearmid, A.; Philip, E. B.; Macleod, M. A., 1963b: *Anim. Prod., 5:* 245.
Ramsbotton, J. M.; Strandine, E. J., 1948: *Fd Res., 13:* 315.
Saiduddin, S.; Riesen, J. W.; Tyler, W. J.; Casida, L. E.; 1968: *Res. Bull. Agric. Exp. Stn Univ. Wis.* No. 270: 15.
Woodhams, Pamela, R.; Trower, Susan J., 1965: *N.Z. Jl agric. Res., 8:* 921.