THE EARLY GROWTH AND HAY CONSUMPTION OF CALVES FED WHOLE OR SKIMMED MILK

K. SANTHIRASEGARAM* and JEAN I. WATTS*

Summary
Calves born during April-May and fed skimmed milk were lower in live and carcass weight, but did not show differences in the volume and weight of the stomach compartments compared with calves fed whole milk. The calves fed skimmed milk consumed more hay during the pre-weaning period, but digested it at the same rate as those fed whole milk. Immediately after weaning, the calves fed whole milk began to eat more hay than those fed skimmed milk. The time spent eating was generally related to the amount consumed, but the calves fed whole milk spent more time ruminating than those fed skimmed milk.

I. INTRODUCTION
Considerable interest has been shown recently by Australian dairy farmers in rearing calves for herd replacement and dairy beef production. Effects of substitutes and whole milk, methods of feeding, time of weaning and housing are of economic interest. Santhirasegaram and others (unpublished data) have studied the effect of varying levels of fat in milk on the early growth of calves born at different seasons and concluded that Friesian-type calves born in late winter-early spring could be successfully raised on skimmed milk and weaned at seven weeks of age. Those born in late autumn-early winter appear to need high energy food (whole milk) for a considerably longer period for satisfactory growth under conditions prevailing at Werribee in Victoria.

Following the work of Godfrey (1961) on the functional development of calves fed whole milk, it was decided to study the growth and development of calves born in April-May, fed either whole or skimmed milk.

II. MATERIALS AND METHOD
(a) Design
The experiment studied the change in liveweight and carcass weight, and the weight and volume changes of the compartments of the stomach and their contents from birth up to 70 days of age at 10 day intervals, of calves fed either whole (4 per cent fat) or skimmed (0.1 per cent fat) milk. At each slaughter period, the fibre, nitrogen and volatile fatty acid contents, pH and in vitro digestibility of the rumen contents, and the nitrogen and fibre contents of the faeces

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wherever available, were determined. A sample of rumen wall from the ventral part of the anterior dorsal blind sac was fixed for histological examination.

Slaughter dates for the various age periods were allotted at random with the staggered arrival of the calves so that age was confounded with time to eliminate seasonal effects. This procedure provided two calves in each treatment for each age period.

(b) Animals and Management

Thirty predominantly Friesian bull calves, born between April and May, 1969, were purchased from dairy farms in the surrounding area on the day of birth and were allotted in pairs to either whole or skimmed milk rearing. Those to

Fig. 1.—Change in liveweight, carcass weight and liver weight of calves fed whole (WM) or skimmed (SM) milk.
receive skimmed milk were changed gradually from whole milk from day 2 to
day 4. From then on, the calves received 3.64 kg/day of the respective milk up to
day 14, and then 4.55 kg/day to the time of slaughter.

All calves were raised in an open concrete paved yard and had access to
chopped hay and water at all times.

(c) Slaughter Procedure

Calves were deprived of milk the previous day and were weighed. On
slaughter, the entire alimentary tract was removed and weighed. From this, the
reticula-rumen was removed and the contents extracted and volume determined;
a portion of the solid and liquid fractions was sampled for chemical and digesti-
bility determinations. The cleaned reticula-rumen was weighed and the distended
volume under water determined according to Harrison et al. (1960). Similar
measurements were made with the omasum-abomasum. The weight of the liver
was also determined. The empty body was skinned, cleaned and weighed after
chilling for 24 h.

(d) Other Measurements

Concurrently, an additional two calves on each diet were raised for 14 weeks
to measure hay intake and faecal output. These measurements were made on three
consecutive days each week. The behaviour of these calves was observed at five
minute intervals for 24 hours on four occasions.

This paper reports the growth of the body and stomach segments, the intake
of hay, and faecal output and the time spent eating and ruminating. The chemical
and histological studies will be dealt with elsewhere.

III. RESULTS

Change in live weight, carcass weight and liver weight are shown in Figure 1.
In all these factors, whole milk (WM) calves were superior to skimmed milk
(SM) calves. In the WM calves, the dressing percentage (carcass weight as a
percentage of liveweight) dropped from 53.5 per cent at birth to 47.0 per cent at
30 days of age and remained constant for the duration of the experiment (Table
1), while in the SM calves, it dropped from the same initial value to 43.0 per
cent at 30 days and then rose to 46.0 per cent towards the completion of the
experiment.

There were no significant or consistent differences in the volume or weight of
the reticula-rumen or omasum-abomasum of the calves in the two treatments, nor
was there a marked or consistent difference in the volume of ingested material
in the reticula-rumen (Table 2).

TABLE 1

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td>53.5</td>
<td>50.0</td>
<td>49.0</td>
<td>47.5</td>
<td>47.0</td>
<td>46.2</td>
<td>47.7</td>
<td>50.3</td>
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<tr>
<td>SM</td>
<td>33.3</td>
<td>31.4</td>
<td>46.5</td>
<td>43.4</td>
<td>40.7</td>
<td>41.8</td>
<td>44.3</td>
<td>46.2</td>
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TABLE 2

<table>
<thead>
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<th>Age (days)</th>
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<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (ml)</td>
<td>WM</td>
<td>525</td>
<td>725</td>
<td>2088</td>
<td>3475</td>
<td>4660</td>
<td>5780</td>
<td>7063</td>
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<tr>
<td></td>
<td>SM</td>
<td>525</td>
<td>1145</td>
<td>1800</td>
<td>4280</td>
<td>4550</td>
<td>5075</td>
<td>7350</td>
</tr>
<tr>
<td>Volume (ml)</td>
<td>WM</td>
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<td>1393</td>
<td>2450</td>
<td>2275</td>
<td>3000</td>
<td>3515</td>
<td>3295</td>
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<tr>
<td></td>
<td>SM</td>
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<td>1050</td>
<td>1513</td>
<td>3135</td>
<td>1100</td>
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<td>2800</td>
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<td>WM</td>
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<td>163</td>
<td>315</td>
<td>535</td>
<td>599</td>
<td>951</td>
<td>990</td>
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<tr>
<td></td>
<td>SM</td>
<td>162</td>
<td>217</td>
<td>243</td>
<td>480</td>
<td>785</td>
<td>803</td>
<td>1055</td>
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<tr>
<td>Weight (g)</td>
<td>WM</td>
<td>250</td>
<td>344</td>
<td>400</td>
<td>380</td>
<td>490</td>
<td>628</td>
<td>815</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>250</td>
<td>290</td>
<td>313</td>
<td>383</td>
<td>585</td>
<td>460</td>
<td>730</td>
</tr>
<tr>
<td>Volume (ml) of ingesta in reticulo-rumen</td>
<td>WM</td>
<td>—</td>
<td>25</td>
<td>1375</td>
<td>3150</td>
<td>3338</td>
<td>6000</td>
<td>6900</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>—</td>
<td>200</td>
<td>625</td>
<td>2400</td>
<td>4900</td>
<td>5800</td>
<td>7600</td>
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The daily intake of hay and excretion of faeces was higher in the SM calves than in the WM calves (180 min/day) up to the time of weaning; thereafter, the relationship was reversed (Figure 2). There was no difference in the apparent digestibility of the hay consumed, which increased from 34 per cent at 3 weeks to 64 per cent at 5 weeks and remained constant to 14 weeks for both WM and SM calves.

The time spent eating per day was longer in the SM calves (240 min/day) than in the WM calves (180 min/day) up to the time of weaning; thereafter, the reverse was true (350 min/day and 410 min/day in SM and WM calves respectively). The time spent in ruminating was erratic but, on the majority of occasions compared, the WM calves appeared to spend more time than SM calves ruminating. SM calves ruminated for 390 min/day both before and after weaning while WM calves ruminated 420 min/day and 490 min/day before and after weaning respectively.

IV. DISCUSSION

The skimmed milk lacked fat (and fat-soluble vitamins) causing a reduction of the energy/protein ratio in the feed; calves fed this milk, particularly in the early stages of their life, lost bodyweight as well as liver weight, indicating the feed was inadequate even for maintenance. They recovered from this and began to gain weight but they remained much lower in bodyweight than those fed whole milk. In spite of early loss in weight and subsequent low bodyweight, the SM calves showed no retardation in the growth of the reticulo-rumen as measured by the weight and volume of the organs. The feeding of the low energy diet caused them to consume more hay, but they did not digest it better than those fed whole milk.

After weaning, the WM calves consumed much more hay than the SM calves, indicating that there was either a sudden increase in the volume of the rumen or that whole milk feeding had caused a better development of the functional layers of the rumen wall which enabled them to digest and absorb the nutrients in the hay at a faster rate.
The structural development of the rumen wall and chemical studies of the rumen contents and faeces will be dealt with separately.

V. ACKNOWLEDGMENTS
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VI. REFERENCES