Roberts, H. E., Worden, A. N. & Evans, E. T. R. (1954). *J. comp. Path.* **64**, 283.
Roy, J. H. B., Huffman, C. F. & Reineke, E. P. (1957). *Brit. J. Nutr.* **11**, 373.
Roy, J. H. B., Shillam, K. W. G., Hawkins, G. M., Lang, J. M. & Ingram, P. L. (1959). *Brit. J. Nutr.* **13**, 219.
Roy, J. H. B., Shillam, K. W. G., Palmer, J. & Ingram, P. L. (1955). *Brit. J. Nutr.* **9**, 94.
Russell, H. K., Page, R. C., Matthews, C. S., Schwabe, E. L. & Emery, F. E. (1941). *Endocrinology*, **28**, 897.
Selye, H. (1936). *Brit. J. exp. Path.* **17**, 234.
Smith, C. A. (1953). *Physiology of the Newborn Infant*, 2nd ed. Springfield, Ill.: C. C. Thomas.
Steinach, E. & Holzknecht, G. (1916*a*). *Arch. EntwMech. Org.* **42**, 307.
Steinach, E. & Holzknecht, G. (1916*b*). *Arch. EntwMech. Org.* **42**, 490.
Thomas, J. W., Okamoto, M., Jacobson, W. C. & Moore, L. A. (1954). *J. Dairy Sci.* **37**, 805.
Voelker, H. H. & Dracy, A. E. (1956). *J. Dairy Sci.* **39**, 929.
Wilkinson, W. S., Pope, A. L., Phillips, P. H. & Casida, L. E. (1954). *J. Anim. Sci.* **13**, 684.
Wing, J. M., Jacobson, N. L. & Allen, R. S. (1955). *J. Dairy Sci.* **38**, 1006.
Wise, G. H., Caldwell, M. J., Parrish, D. B., Flipse, R. J. & Hughes, J. S. (1947). *J. Dairy Sci.* **30**, 983.
Yates, F. (1933). *Emp. J. exp. Agric.* **1**, 129.

The effect of giving stilboestrol and chlortetracycline to colostrum-fed calves

By JILL M. LANG, J. H. B. ROY and K. W. G. SHILLAM

National Institute for Research in Dairying, Shinfield, Reading

and P. L. INGRAM

Department of Pathology, Royal Veterinary College, Camden Town, London, N.W. 1

(*Received* 13 *April* 1959)

In an earlier paper, Hawkins, Roy, Shillam, Greatorex & Ingram (1959) showed that 1·5 mg stilboestrol given daily by mouth significantly increased the growth rate of newborn calves, although it appeared to increase slightly the incidence of scouring. As Roy, Shillam, Palmer & Ingram (1955) have shown that chlortetracyline reduced the incidence of scouring and increased weight gain of colostrum-deprived calves, it seemed probable that chlortetracycline and stilboestrol when given together to calves might produce an increase in live-weight gain greater than that obtained with either supplement alone.

An earlier experiment (Ingram, Shillam, Hawkins & Roy, 1958) was planned to study the protective action of antibiotics against *Escherichia coli* septicaemia, the usual post-mortem finding in calves that die after having been deprived of colostrum. In the experiment reported here all calves were given initially a small amount of colostrum to give protection against this septicaemic form of white scours. Information could thus be obtained on the value of chlortetracycline in protecting calves from death associated with an *E. coli* localized intestinal infection (Wood, 1955), the usual post-mortem finding in those colostrum-fed calves that die.

Colostrum-fed calves were therefore given either stilboestrol (3,4-di-*p*-hydroxyphenylhex-3-ene), chlortetracycline or a mixture of the two.

Comparison was also made of the effect of giving the basal diet twice daily during the first 10 days of life as against three times daily as practised in our previous experiments.

METHODS

Plan of experiment

The experiment was done in the autumn of 1956. The calfhouse used had contained sixteen calves, mostly for a few days only, since the previous spring. A randomized-block design was used with four treatments in each of fourteen blocks as follows:

Treatment no.	Initial diet	Supplement given (for quantity see below)
40	400 ml separated colostrum	None
41		Chlortetracyline
42		Stilboestrol
43		Stilboestrol and chlortetracycline

Calves in alternate blocks were fed twice or three times daily during the first 10 days of life and thereafter all were fed twice daily. Eight of the blocks consisted of Shorthorn bull calves and six of Ayrshires.

Diet and supplements

Basal diet. The calves were reared on bulked whole milk from the Institute herd for 3 weeks, the daily allowance being 1 lb/10 lb live weight except when scouring occurred (see below).

Separated colostrum. Colostrum was collected, separated and stored in the same manner as in earlier experiments (Aschaffenburg, Bartlett, Kon, Roy, Sears, Thompson, Ingram, Lovell & Wood, 1953). Each calf received as its first meal within 12 h of birth 400 ml separated colostrum (100 ml from each of four batches).

Stilboestrol. Stilboestrol, 1·5 mg, was given at birth and daily at the morning feed to the calves on treatments nos. 42 and 43 in the same manner as in the earlier experiment of Hawkins *et al.* (1959).

Chlortetracycline. Chlortetracycline hydrochloride (Cyanamid of Great Britain Ltd), 125 mg, was given at birth and daily at the morning feed to each calf on treatments nos. 41 and 43.

Calves

Collection and management of the calves and treatment at the onset of scouring were as described by Roy *et al.* (1955).

RESULTS

Of the twenty-eight calves given no chlortetracycline, ten died, whereas of those given chlortetracycline all except one survived. The giving of stilboestrol did not affect the mortality rate.

Analysis of the mean daily live-weight gain by multiple covariance and adjustment for the affecting variables, birth weight and total milk consumption, showed that the

Table 1. *Comparison of the performance (mean values with their standard errors†) of colostrum-fed calves given stilboestrol, chlortetracycline or a mixture of the two*

(Each calf received 400 ml separated colostrum as its first feed)

	Treatment no.				
	40 (no supplement)	41 (chlortetra-cyline)	42 (stilboestrol)	43 (stilboestrol and chlortetra-cycline)	Significance of difference between treatments
Calves: no. used	14	14	14	14	—
no. died	6	1	4	0	40 > 43*; 40+42 > 41+43**
Age at death (days)	9±2	9	10±2	—	—
Live-weight gain/day of surviving calves (lb)	0·33±0·08	0·52±0·06	0·51±0·07	0·53±0·06	—
No. of days on which surviving calves scoured	4±1·0	4±0·7	3±0·3	4±0·4	—
No. of days on which surviving calves had a high rectal temperature (> 102·8° F)	2±0·6	2±0·6	2±0·8	2±0·5	—
Time between birth and complete passage of meconium (h)	39·9±1·9	42·8±1·8	47·0±2·0	45·4±2·2	42 > 40*
Adjusted live-weight gain/day of surviving calves (lb)‡	0·39±0·04	0·50±0·03	0·45±0·04	0·53±0·03	43 > 40*; 41 > 40*

* Significant at $P < 0·05$. ** Significant at $P < 0·01$.

† In calculating the standard errors the arrangement in blocks has been ignored.

‡ See p. 464.

growth rate of the calves given chlortetracycline with or without stilboestrol was significantly greater ($P < 0.05$) than that of calves that did not receive chlortetracycline. The giving of stilboestrol did not significantly affect growth, although the live-weight gain of calves given stilboestrol tended to be greater than that of calves given no supplement. However, the mean growth rate of calves given both chlortetracycline and stilboestrol was only slightly greater than that of calves given chlortetracycline alone. The relevant partial regression coefficients with their standard errors are given below (the adjusted mean values are given in Table 1):

	General mean	Partial regression coefficient with its standard error
Live-weight gain/day (lb)	0·478	—
Birth weight (lb)	78·82	−0·0215 ± 0·0028***
Total milk consumption (pints)	122·20	+0·0179 ± 0·0017***

*** Significant at $P < 0.001$.

The incidence of scouring and of a high rectal temperature (above 102·8° F) in the surviving calves was not affected by treatment, nor did the number of feeds given daily during the first 10 days of life have any effect on the variables studied.

Calves given stilboestrol alone passed meconium significantly more slowly than the control calves.

Table 2 shows the post-mortem findings on the calves that died. Of the eleven deaths, ten were associated with an *E. coli* infection. Eight of the deaths were associated with an *E. coli* localized intestinal infection and only two with an *E. coli* septicaemia.

Table 2. *Number of calves that died, classified according to post-mortem finding*

(Each calf received 400 ml separated colostrum as its first feed)

		Treatment no.			
	Post-mortem findings	40 (no supplement)	41 (chlortetracycline)	42 (stilboestrol)	43 (stilboestrol and chlortetracycline)
E. coli	Septicaemia and polyserositis	1	0	1	0
	Localized intestinal infection	4	1	3	0
Pseudomonas	Pleurisy, pneumonia, rumenitis and nephritis	1	0	0	0

DISCUSSION

Our finding in the earlier experiment (Hawkins *et al.* 1959) that stilboestrol, when given by mouth, significantly improved the growth rate of newborn calves has not been confirmed in this study, although there was some indication that calves given stilboestrol grew at a faster rate than the controls.

Unlike in the earlier experiment, there was no indication that the incidence of scouring of calves given stilboestrol was greater than that of control calves.

Calves given stilboestrol in combination with chlortetracycline grew at a significantly faster rate than those given no supplement. However, most, if not all, of this growth stimulation must have been due to the action of the antibiotic, for live-weight gains of calves given chlortetracycline alone were similar to those of calves given both supplements, and greater than those of calves given no supplement.

The results of this experiment show clearly that chlortetracycline will protect calves given small quantities of colostrum against death from a localized intestinal infection associated with *E. coli*, as well as from the *E. coli* septicaemia of colostrum-deprived calves (Ingram *et al.* 1958).

SUMMARY

1. Fifty-six newborn bull calves (thirty-two Shorthorns and twenty-four Ayrshires) were used in an experiment to establish the effect of giving stilboestrol (3,4-di-*p*-hydroxyphenylhex-3-ene) and chlortetracycline by mouth to colostrum-fed calves.

2. Fourteen calves were each given 125 mg chlortetracycline/day, fourteen were each given 1·5 mg stilboestrol/day and fourteen were each given 125 mg chlortetracycline and 1·5 mg stilboestrol/day. The fourteen remaining calves were given no supplement, and all were reared on whole milk for 3 weeks after an initial feed of 400 ml separated colostrum.

3. Stilboestrol had no effect on the incidence of scouring or mortality, and only a slight but non-significant effect on growth rate.

4. Chlortetracycline, with or without stilboestrol, significantly reduced the mortality associated mainly with a localized intestinal infection with *Escherichia coli* and increased the weight gain of the surviving calves.

REFERENCES

Aschaffenburg, R., Bartlett, S., Kon, S. K., Roy, J. H. B., Sears, H. J., Thompson, S. Y., Ingram, P. L., Lovell, R. & Wood, P. C. (1953). *Brit. J. Nutr.* **7**, 275.

Hawkins, G. M., Roy, J. H. B., Shillam, K. W. G., Greatorex, J. C. & Ingram, P. L. (1959). *Brit. J. Nutr.* **13**, 447.

Ingram, P. L., Shillam, K. W. G., Hawkins, G. M. & Roy, J. H. B. (1958). *Brit. J. Nutr.* **12**, 203.

Roy, J. H. B., Shillam, K. W. G., Palmer, J. & Ingram, P. L. (1955). *Brit. J. Nutr.* **9**, 94.

Wood, P. C. (1955). *J. Path. Bact.* **70**, 179.