END OF PROJECT REPORT

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EFFECT OF TRANSPORT AND MART EXPERIENCE ON PRODUCTION, HEALTH, IMMUNE AND PHYSIOLOGICAL PARAMETERS OF 2 TO 4 WEEK OLD CALVES

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Summary and Implication

This study examined the effects of transporting dairy calves (less than four weeks of age), on a journey of 170-mile-route to and from a mart in Spring 1996 and 1997, Calf performance, immunological and physiological variables were examined prior to and subsequent to transport.

There was no effect of treatment on liveweight or intakes at any time throughout the experiment.

Interferon γ production was reduced in all treatment groups on days 1, 2 and 5, compared to Day 0 in experiment 1, indicating that even the procedures imposed on the control (C) calves had been sufficient to cause suppression of this component of the immune response.

Calves in all treatment groups in Experiment 1, had increased ($P<0.05$) cortisol concentrations at Day 0.5 (post-transport on Day 0) and experienced physiological changes related to food restriction, e.g., increased ($P<0.05$) plasma non-esterified fatty acids (NEFA) on Day 0.5.

Cortisol levels remained low on days 1, 2 and 5 after the journey and there was no obvious response in the levels of either plasma glucose or haematological parameters indicating that the calves did not show a stress response following transportation and/or mart experience.

Transportation of 2 to 4 week old calves had no effect on plasma haptoglobin (acute phase response) levels indicating that the calves did not experience a stress response which would affect cell mediated immunity. The acute phase response is the reaction of the animal to disturbances in its homeostasis caused by infection, tissue injury, stress or immunological disorders.

The absence of significant stressful responses in young dairy calves following transportation and mart experience could be interpreted as indicating that transport did not pose significant welfare problems.

Introduction

Transportation invariably involves a series of handling and confinement procedures and social regrouping of animals all of which are stressful to the domestic animal (Grandin, 1997). In addition, transportation and sale of young calves through auction marts often coincides with a change in ownnership and management of the calf which may adversely affect its welfare. Transport has been recognised for a long time as being critical in animal production (Hails 1978; Daigtzen and Mormede 1979).

Some of the most basic indicators of overall welfare of an animal are growth rate, feed intake and health. Physiological and ethological parameters are also used to determine the welfare status of animals. Several studies have been conducted to determine the short-term effects of transport and associated factors (e.g. loading, journey duration) on calves (Knowles *et al.,* 1997; Mormede *et al.*, 1982, Staples and Hague, 1974). Most of these studies have shown a transient acute physiological response to transport and handling (characterised by increased cortisol concentrations) along with other biological responses which are related mainly to the duration of food and water deprivation. Few studies have considered the longer term effects of transport and/or method of sale (e.g., mart) on calf welfare. Mormede *et al.* (1982) reported that the duration of the "whole procedure" experienced at sale by 2 to 4 week old calves had a significant effect on the incidence of ill-health during the subsequent three weeks. However, Staples and Hauge (1974) found no relationship between the distance travelled (50 to 400 miles) by 2 to 4 week old calves and subsequent morbidity (60%) or mortality (22%) levels. In contrast, they found a significant effect of source of calves which was related to the individual source of calves and not the method of sale. It is difficult to conclude from previous studies what factors (if any) within a transport and/or sale experience affect subsequent welfare. This is due in part to the lack of 1) control of husbandry procedures and 2) knowledge of the health status of the calves pre experience.

Objectives

Therefore the objectives of the present series of experiments were: (1) to determine the effect of transport and sale of young dairy calves on their subsequent health and welfare compared with calves maintained on the farm of origin; (2) to examine the medium term effect of transport and mart-sale of calves on the overall welfare of

calves compared with the effect of (a) transport only, and (b) maintenance of calves at the farm of origin; where some factors known to affect welfare (e.g., food restriction) were controlled.

Material and Methods

Three experiments were conducted over an 18 month period. 70 Spring-born and 35 Autumn-born dairy x calves (male) were purchased from local farmers within a radius of 15 miles and brought to Grange Research Centre within 24 - 48 h of birth (3 Spring-born and 1 Autumn-born calves died and were excluded from the statistical analyses). Each farmer was requested to ensure that the calves received adequate colostrum intake especially within the first 6 h of birth. At the Research Centre the calves were reared individually in straw bedded calf hutches outdoors. This eliminated physical contact between calves.

Calves in Experiment 1 were fed 2 litres of warm calf milk replacer twice daily and calves in Experiment 2 and 3 were fed 2 litres of whole milk twice daily**,** at approximately 08.00 and 16.00 h. Concentrates were available from 10 days of age. Calves in Experiments 1 and 2 were allocated to the following treatments based on the Zinc Sulphate turbidity test (ZST) and bodyweight (BW) on Day A (Day of arrival at Grange Research Centre) and age on day of transport (Day 0) (Table 1); (n = 10 per group and n=12 per group, respectively): 1) control (C) maintained at Research Centre, 2) transport + mart (T+M) and 3) transport only (T). The C and T calves had no access to food or water for the same duration as that experienced by the T+ M calves.

Calves in Experiment 3 were allocated to the same three treatments as those in Experiments 1 and 2; C (n=12), T+ M (n =11) and T (n=11); however, there was also a control group of animals that had allowed normal access to food and water all day (CF; n=8) (Table 1). Both the T+M and T calves travelled the same 170-mile-route at a stocking density of 0.65m^2/calf and only the duration of the whole experience differed between the two groups. Both groups left the Research Centre at 07.00 h. The T group returned at 14.00 h approx. while the T + M group returned at 16.00 h. The maximum speed allowed was 40mph. Both the journey time and distance travelled are within EU regulations. All the calves were between 2 and 4 weeks of age when transported and they were bedded on straw during the journey. The

faeces (1 = normal to 3 = bad scour) and appearance (1 = healthy to 3 = recumbent) of each calf was scored and rectal temperatures taken and scored daily (1 = normal to 3 = very high or very low). All scores were combined to form a total daily health score/calf and all medical interventions were recorded daily. Intakes were determined daily and bodyweights were recorded weekly. Serum samples were collected on days A, 0, 0.5, 1, 2, 5, 7, 14, 21, 28, 35 and 41 of the experiment.

The zinc sulphate turbidity (ZST) test was performed on calf serum samples on days A, 0, 0.5, 1, 2 and 5 of the study. Blood samples for interferon-γ determination were collected by jugular venipuncture into aseptic vacutainer tubes containing lithium heparin on days 0, 1, 2, 5 and 8 of the experiment. Blood samples for haptoglobin (an acute phase protein) were collected on days A, 0, 0.5, 1, 2, 5 and 8 of the experiment. The stimulated lymphocyte production of interferon-γ was determined following whole blood culture of heparinised samples using an ELISA procedure (CSL, Biosciences, Parkville, Victoria, Australia). The physiological parameters measured were: red blood cell number (RBC), haemoglobin (Hb), packed cell volume (PCV), mean cell volume (MCV), total white cell count (TWC), platelet number, % lymphocytes and haematocrit. Haematology parameters were determined for unclotted (K_3-EDTA) whole blood samples using an electronic particle analyser (Celltac MEK-610K). Plasma cortisol concentrations were determined using a commercially available RIA kit on days 0, 0.5, 1, 2 and 5 of the experiment.

Table 1. Bodyweights and zinc sulphate turbidity (ZST) Units for all calves on Day A (Day of arrival at Grange Research Centre) and age of calves on day 0 of the experiment. The values are expressed as Mean ± S.E.M. n ≥ 10 calves per treatment.

	Bodyweight (Kg)	**ZST (Units)**	**Age on day of transport (days)**
Experiment 1 (Spring 1996)			
Control (C)	**45.3**	**14.5**	**24**
	± 0.63	± 0.06	± 1.0
Ttransport (T)	**46.1**	**14.1**	**23**
	± 0.56	± 1.1	± 1.2
Transport + Mart (T + M)	**46.2**	**16.2**	**24**
	± 0.87	± 1.1	± 1.1
Experiment 2 (Spring 1996)			
Control (C)	**45.6**	**13.4**	**18**
	± 0.71	± 1.6	± 0.63
Ttransport (T)	**46.5**	**14.2**	**18**
	± 0.72	± 2.1	± 0.49
Transport + Mart (T + M)	**46.9**	**16.2**	**18**
	± 0.66	± 1.7	± 0.55
Experiment 3 (Spring 1997)			
Control (C)	**44.1**	**12.3**	**16**
	± 0.72	± 1.6	± 0.47
Ttransport (T)	**44.6**	**13.5**	**16**
	± 0.97	± 1.3	± 0.44
Transport + Mart (T + M)	**43.6**	**12.5**	**16**
Control + Feed (C+F)	± 0.72	± 0.96	± 0.46
	38.6	**11.8**	**16**
	± 0.91	± 0.91	± 0.58

Results

Experiment 1

There was no effect (P > 0.1) of treatment on bodyweight or intakes at any time throughout the experiment or on the overall ADG. Figure 1a shows the bodyweight of calves in treatments from day 0 to day 41 of the experiment. There were no

differences (P > 0.1) between C, T or T+M calves for any of the haematological or biochemical parameters measured. The combination of the low interferon γ production and high total white cell counts (Figure 1b and 1c) in the T+M group at time 0 (pre-transport) indicates that this treatment group of animals were immunologically compromised prior to transport. Thus, the apparent difference in the number of medical interventions for pneumonia in the 2 weeks immediately after their transport and mart experience does not necessarily represent an effect of the experience. Figures 1d and 1e, respectively, show the number of medical interventions and total number of calves treated for scour and pneumonia at various stages throughout the experiment. Interferon γ production was reduced in all treatment groups on days 1, 2 and 5, compared to Day 0, indicating that even the procedures imposed on the C calves throughout this day may have been sufficient to cause suppression of this component of the immune response. The white blood cell is responsible for both antibody and cell-mediated immune responses, therefore any alteration in the number and/or functioning of these cells will impair the natural defence mechanisms. Haptoglobin is an acute phase protein of infection that is produced by the liver in response to elevated blood tumour necrosis factor -α (TNF α) concentrations and to stressful responses. There was no significant change in plasma haptoglobin levels either prior to transport on Day 0 or on the days following transport (0.5, 1, 2, 5 and 8) (Day 0 C 0.11; T 0.13; T+M 0.07 ; Day 1 C 0.11; T 0.15; T+M 0.11 g Hb/l).

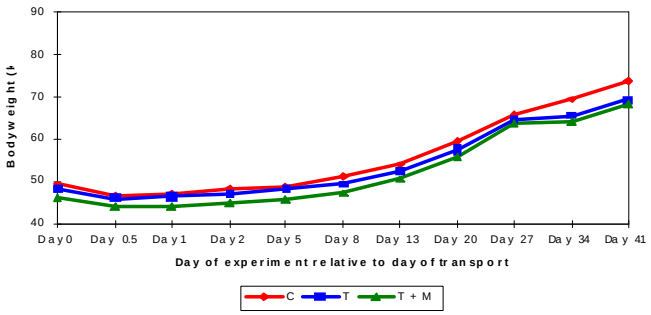
Calves in all treatment groups had increased ($P<0.05$) cortisol concentrations (C 12.9 T 11.3; T+M 18.9 nmol/l) at Day 0.5 (post-transport on Day 0) and experienced physiological changes related to food restriction, e.g. increased ($P<0.05$) plasma non-esterified fatty acids (NEFA) on Day 0.5 (C 0.47; T 0.32; T+M 0.37 v. day 0 C 0.06; T 0.04; T+M 0.03 mmol/l). Raised plasma cortisol concentrations reflect activation of the pituitary-adrenal axis, whereas elevated NEFA levels reflect activation of the sympathetic-adrenomedullary system.

Conclusion

Overall, there was no significant effect of transport and mart experience on the performance, immunological and haematological indices and subsequent health status of calves. These results suggests that the welfare of young calves is not compromised following transport and/or mixing of calves.

Figure 1 Effect of treatment on a) Bodyweights, b) total white cell counts, c) gamma interferon levels, d) total number of medical interventions given (scour and pneumonia) treatment, and e) total no. of animals treated in each group during three time periods relative to the day of transport (Day 0).

a)



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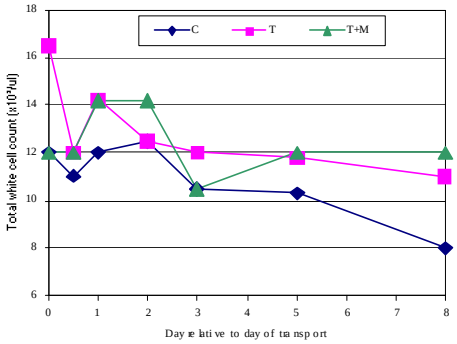

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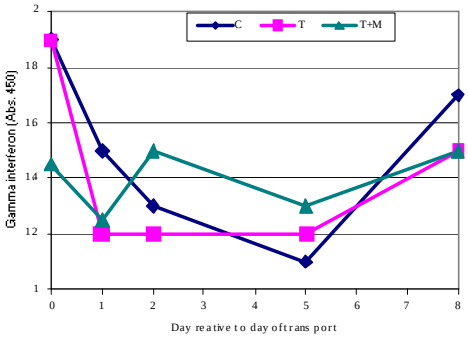

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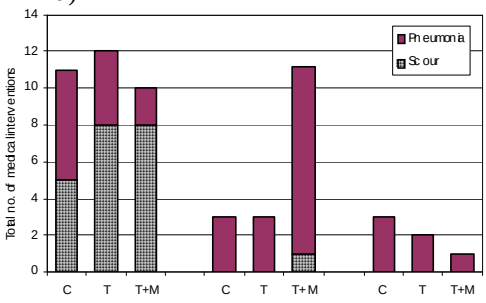

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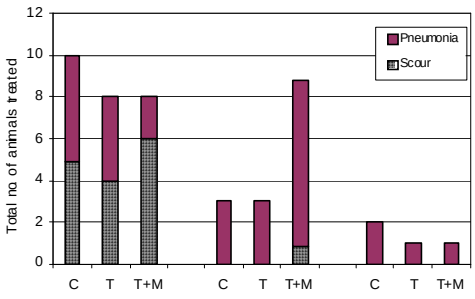


Day –14 to 0 Day 0.5 to 14 Day 15 to 28

Day –14 to 0 Day 0.5 to 14 Day 15 to 28

Results

Experiment 2

Experiment 2 was designed to further elucidate the findings and implications taken from the data in Experiment 1. The age range of the calves in Experiment 2 was reduced by 6 days (14 to 21 days of age on Day 0) in order to minimise possible variation noted in some physiological variables in Experiment 1.

There was no difference ($P>0.05$) in body weights, ADG or feed intakes at any time throughout the experiment. Figure 2a shows the bodyweights of calves in the three treatments from day 0 to day 41 of the experiment. There was no difference ($P<0.05$) in any of the haematological or biochemical parameters measured. Figures 2b and 2c show the number of medical intervention and total number of calves treated, respectively at various times throughout the experiment. Figure 2d shows the total white cell counts from day 0 to day 5 of the experiment.

Conclusion

Overall, there was no significant effect of transport and mart experience on calf performance, haematological indices and subsequent health status. These results are in agreement with the findings of Experiment 1. and lends further support to the conclusion that the welfare of young calves is not compromised following transport and/or mixing.

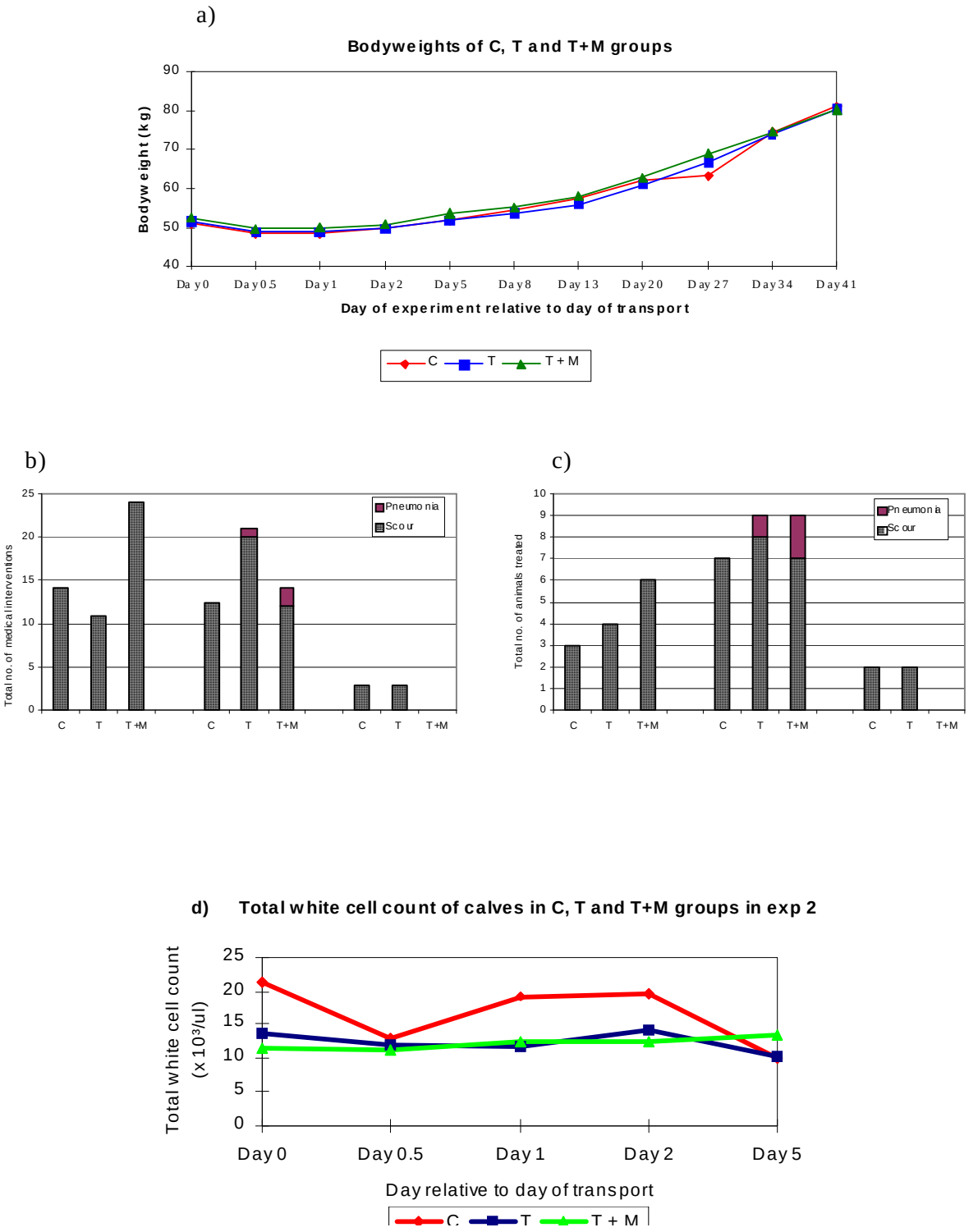


Figure 2 Effect of treatment on a) Bodyweights, b) total number of medical interventions given (scour and pneumonia treatment), and c) and total no. of animals treated in each treatment group during three time periods relative to the day of transport (Day 0) and d) total white cell counts.

Results

Experiment 3

In order to confirm the findings of the previous experiments, an additional treatment, no transport and fed (CF), was included in this experiment to determine if the restriction of food and water from 06.30 to 17.00 on Day 0 in the C calves would have a detrimental effect on the subsequent health and welfare status of these calves. The calves in CF group were fed as normal throughout Day 0 while the calves in the other treatment groups had no access to food or water (see Table 1).

Similar to the findings reported in Experiments 1 and 2, there was no effect of treatment ($P>0.05$) on body weight, ADG, feed intakes or of feed restriction. As in Experiments 1 and 2 there was no difference ($P>0.05$) in any biochemical or haematological parameters measured. Figure 3a shows the bodyweight of calves in all treatments from day 0 to 41 of the study. No differences were recorded in any of the biochemical or haematological parameters measured.

Figures 3b and 3c shows the total number of medical interventions given and the total number of calves treated for scour and pneumonia respectively throughout the experiment.

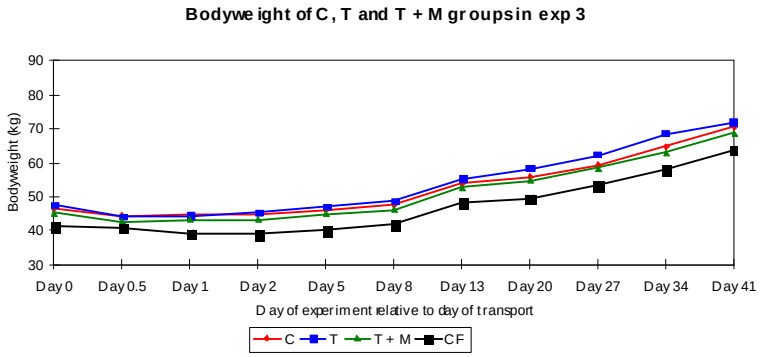
Figure 3d shows the total white cell count from day 0 to day 5 of the experiment.

Conclusion

The health and performance of calves was not adversely affected in any treatment group. As previously reported in Experiment 1 and 2, this study also confirmed that there was no impairment of performance or of health and welfare indicators following transportation and/or mixing of young calves.

Figure 3 Effects of treatment on a) Bodyweights, b) the total number of medical interventions given (scour and pneumonia treatment) and total no. of animals treated in each treatment group during three time periods relative to the day of transport (Day 0), and d) total white cell counts.

a)



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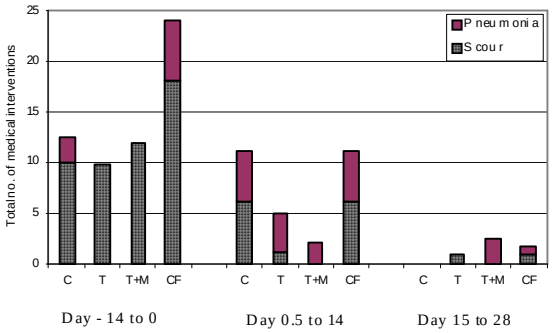

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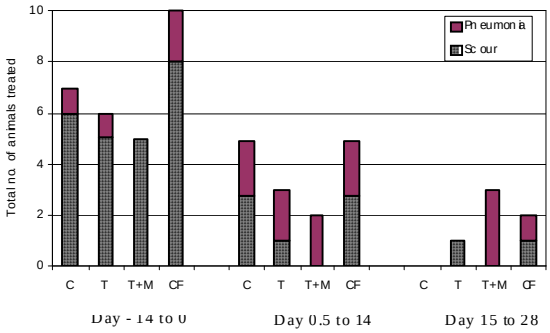

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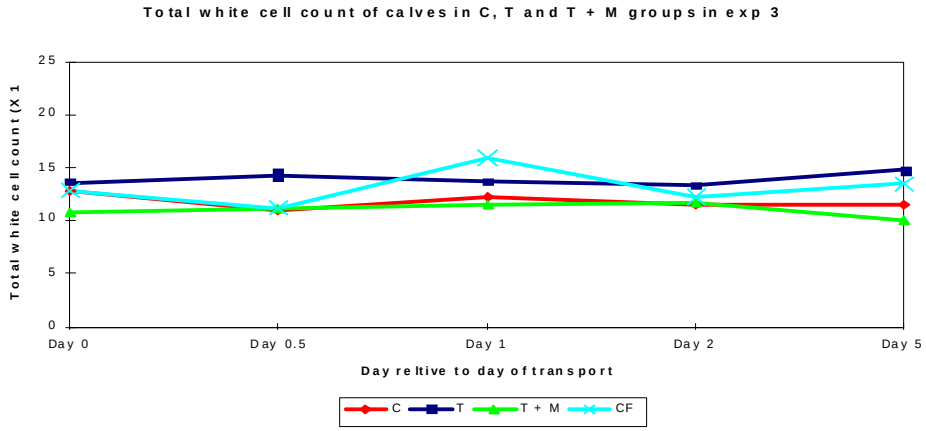

Discussion

The transport (170 miles) and/or sale experience of 2 to 4 week old calves through marts did not affect their subsequent health and welfare compared with calves which remained *in situ*.

A combination of handling of these young calves (e.g. weighing and blood sampling) with limited food/water restriction caused a similar decrease in interferon-γ production in all treatment groups, i.e. calves *in situ* showed the same decrease as those transported and experiencing sale. This indicates that this experience was a stressor and caused the suppression of this cell-mediated immune response. Interferon-γ is an important regulator of natural killer (NK) cell activity. NK cells respond to an antigen by producing interferon-γ which in turn promotes antibody-mediated phagocytosis.

Calves which had sub-clinical signs of disease (e.g., high white blood cell counts) before transport and sale, which were subsequently transported, became ill within days of transport.

Plasma haptoglobin (measure of acute phase response) was determined on days A, 0, 0.5, 1, 2, 5 and 8. Haptoglobin is an acute phase protein of infection that is produced by the liver in response to elevated blood tumour necrosis factor -α (TNF α) concentrations. Raised haptoglobin levels reduce lymphocyte function and therefore reduces cell mediated immunity. There was no effect of transportation on plasma haptoglobin levels in the present experiment.

Conclusion

The transport 2 to 4 week old to marts and/or the sale experience produced no adverse effects on the subsequent health, animal welfare indices or performance in the 6-week period following transport.

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