The Relationship Among Current Management Systems, Production, Disease and Drug Usage on Ontario Dairy Farms

A.H. Meek, S.W. Martin, J.B. Stone, I. McMillan, J.B. Britney and D.G. Grieve*

ABSTRACT

The study involved 110 randomly selected dairy farms located in the Ontario, Canada counties of Bruce, Grey, Huron, Oxford, Perth, Waterloo and Wellington. Herds were classified as "intensive" and "extensive". On extensive farms, data were collected at the herd level only, while on intensive farms, data were recorded at both the individual animal and herd level. Data collection continued for approximately two and one-half years. At each visit, technicians collected production data from the most recent production recording scheme report and from the "daily log" maintained by each producer. As well as the ongoing data collection procedures, a number of supplementary data collections were made.

The average 305 day milk production increased gradually during the three calendar years from 6224.6 kg in 1981 to 6443.7 kg in 1983. The average calving interval was stable at 13.2 months for all three years.

The majority of cows removed from the herds were culled for beef (0.243 per animal year). The next highest removal rate was for domestic sale, followed by death, export sale and destroyed. The highest disease rate, for those conditions whose rates were based on calving, was for retained placenta (0.09 per calving), while clinical mastitis was highest for those conditions whose rates were based on animal years (0.37 per animal year). The overall crude antimicrobial dosage rate, that is, including any antimicrobial used for either prophylactic or therapeutic purposes, was 3.85 doses per animal year. The rate for therapeutic purposes only was 3.6 doses per animal year. Penicillin/streptomycin was used most often with a rate of 1.45 doses per animal year.

Key words: Agricultural system, disease occurrence, drug usage.

RÉSUMÉ

Cette étude portait sur 110 troupeaux laitiers choisis au hasard et classifiés comme intensifs ou extensifs, dans les comtés ontariens suivants: Bruce, Grey, Huron, Oxford, Perth, Waterloo et Wellington. La collection des données s'échelonna sur une période de deux ans et demi; dans les troupeaux classifiés d'intensifs, elle s'appliquait tant à chacune des vaches qu'au troupeau pris dans son ensemble, tandis que dans les troupeaux dits extensifs elle ne s'appliquait qu'au troupeau pris dans son ensemble. À chacune de leurs visites, les techniciens enregistraient les données relatives à la production lactée, à partir du plus récent rapport du plan d'enregistrement de cette production et du "log quotidien" maintenu par chaque producteur; ils colligèrent en même temps un certain nombre d'autres données.

De 1981 à 1983, la production moyenne des lactations d'une durée de 305 jours passa graduellement de 6224,6 kg à 6443,7 kg et l'intervalle moyen entre les vêlages se situa, de façon stable, à 13,2 mois.

La majorité des vaches éliminées de ces troupeaux furent envoyées à l'abattoir (0,243 par année animale). Le plus haut taux de réforme suivant concernait la vente domestique; venaient ensuite, par ordre décroissant: la mort, l'exportation et l'euthanasie. Le taux de maladies le plus élevé et relatif aux conditions dont le taux était relié au vêlage, concernait la rétention placentaire (0.09 par vêlage); la mammite clinique s'avéra par ailleurs la plus fréquente des conditions dont le taux se basait sur les années animales (0,387 par année animale). Le taux brut global d'antibiothérapie, i.e. qui tenait compte de n'importe quel antibiotique utilisé à des fins prophylactiques ou thérapeutiques, atteignit 3,85 doses par année animale. L'antibiothérapie strictement thérapeutique atteignit par ailleurs 3,6 doses par année animale. L'utilisation d'un mélange de pénicilline et de streptomycine se révéla la plus fréquente; elle afficha un taux de 1,45 doses par année animale.

Mots clés: système agricole, incidence des maladies, utilisation de médicaments.

INTRODUCTION

Agriculture can be thought of as being manipultive ecology with its basic operational units being production systems. Animal production systems are complex. They are composed of, and are influenced by, interactions among, biological, climatic, economic, social and cultural factors. The biological component includes a hierarchy of plants and animals which are manipulated to provide high productivity; disease is a frequent by-product of this interaction and diverts useful energy into nonuseful (from a human point of view) products. Because of the complexity of production systems, decisions

*Ontario Veterinary College (Meek, Martin) and Ontario Agricultural College (Stone, McMillan, Britney, Grieve), University of Guelph, Guelph, Ontario N1G 2W1.

Submitted October 25, 1984.

based on simple analyses, often involving only a few factors may not be effective in improving the efficiency of the system.

For the above reasons, agricultural advisory services should focus on production systems and integrate technical and economic advice with both the available management strategies and owner abilities. Such an all-inclusive view of how best to assist primary farm enterprises necessitates coordination of the roles traditionally performed separately by the animal scientist, farm management specialist and the veterinarian, and hence cooperation between members of these groups. The need for such cooperation is well recognized by advocates of the "systems approach" (1).

The systems approach is basically concerned with either natural or man-made factors viewed as sets of interacting elements. Thus, in systems terms, a farm consists not merely of its basic components, but also of the pattern of associations among and within these components. It is also concerned with the resources used in and the products resulting from farm activities. However a farm system is conceptualized, it is important to quantify the relationships among factors within it as well as those that have impact on it. Such quantification will lead to better management of the system and hence to improved health of the animals and optimum productivity. The project outlined in this report has attempted to employ these concepts and approaches.

This interdisciplinary three year project was begun in 1980 and involved researchers from both the Ontario Veterinary College (OVC) and the Ontario Agricultural College (OAC), University of Guelph.

Specifically, the objectives of the project were:

1. To investigate the associations among production, disease occurrence, drug usage, husbandry/management practices and the social and personal characteristics of Ontario dairymen.
2. To identify management strategies that are consistent with good productivity, both biological and economic, while at the same time minimizing health problems and drug usage.

This paper outlines the nature and scope of the project and summarizes preliminary results available to December 1983. The economic component will be investigated through the use of computer simulations and be presented separately.

MATERIALS AND METHODS

HERD SELECTION

The study was geographically limited to the Ontario counties of Bruce, Grey, Huron, Oxford, Perth, Waterloo and Wellington. These counties were chosen because they were conveniently located near Guelph and because they were judged to be representative of Ontario with respect to dairying.

One hundred and ten dairy farmers were selected for the project. The 110 producers were randomly selected from a list of all producers in the above counties who had Holstein cattle and who had been enrolled on a supervised production recording program (Ontario Dairy Herd Improvement Corporation (ODHIC), or Record of Performance (ROP) with milk samples centrally processed) for a minimum of five years. A letter describing the nature of the project was sent to each selected producer and over 75% of those initially contacted volunteered to participate. For each negative response received, an alternate producer was randomly selected and approached. After 110 volunteer producers had been enrolled, local meetings were held to discuss the project in more detail. Data collection commenced in October 1980.

DATA COLLECTION

Herds were classified into two types, namely, "intensive" and "extensive". On extensive farms, data were collected at the herd level only, while on intensive farms, data were recorded at both the individual animal and herd level. This was done in order that analyses could be conducted and conclusions drawn at both the individual animal and herd level. Initially, there were 38 intensive and 72 extensive herds. (Table I)

An inventory of animals, including basic demographic information (e.g. sire, dam and birth date) was taken at the initial farm visit. Thereafter, technicians visited each herd approximately ten times per year. Data collection continued for two years on the extensive farms and for two and one-half years on the intensive ones.

At each visit the technicians collected data from the most recent production recording scheme report and from the "daily log" maintained by each producer. The log was a form with columns for date, animal identification, event (e.g. specific disease occurrence) and treatment (the drug used, its route of administration and the number of times administered). Disease occurrence was recorded as the clinical diagnosis made by the farmer and/or his veterinarian. On intensive farms, the data collected from the production recording scheme report consisted of individual cow calving and drying off information, the appropriate production informa-

TABLE I. Geographic Distribution of Herds

	Initial[a]			Final[b]		
County	Intensive[c]	Extensive	Total	Intensive	Extensive	Total
Bruce	4	17	21	3	16	19
Grey	5	7	12	5	6	11
Huron	3	14	17	3	12	15
Oxford	13	12	25	10	11	21
Perth	8	11	19	8	10	18
Waterloo	2	1	3	2	1	3
Wellington	3	10	13	3	10	13
Total	38	72	110	34	66	100

[a]Enrolled in project and commenced data collection in the fall of 1980
[b]Completed data collection phase of project, summer 1983
[c]Farm classification, see text for explanation

tion (i.e. test day, 305-day or completed lactation data), sire and dam data and removals and additions to the herd. Summarized herd production data were also collected. On intensive farms only, the identity of each female calf born since the previous farm visit was checked at each visit by the technicians. Health and productivity data on the calves were monitored to weaning. As well as the ongoing data collection procedures, a number of supplementary data collections were made. The results of some of these are reported here, while others have been reported elsewhere or are currently being analysed. For purposes of presenting an integrated overview of the project, these are briefly introduced.

Feed and Water Samples — Roughage samples were collected for analysis during the winter (Jan.-Feb.) of 1981, and during the fall of each of 1981 and 1982. Water samples were collected during the fall and early winter of 1981.

Surveys — All herd owners were asked to participate in five surveys. The first of these was conducted during the summer of 1981 and involved an assessment of the dairyman's husbandry/management practices as well as detailed data on the physical plant. The second and third surveys were both conducted early in 1982 and dealt respectively with an assessment of the manager's socio-psychological characteristics and with his calf rearing practices. The influence of socio-psychological characteristics and management practices on farm performance have been reported elsewhere (2,3). Two feeding management surveys were conducted during 1981. The first was aimed at assessing practices used during the winter and the second involved an assessment of the summer period. The results of these latter surveys, describing the effect of feed and feeding management on production and disease occurrence, have been reported elsewhere (4).

Blood Samples — Blood samples were taken from all milking cows in the intensive herds on two separate occasions. The first sampling was done during the summer of 1982, while the second was done during the summer of 1983.

FEEDBACK TO FARMERS

One of the potential problems with an observational study of this nature, is that the study *per se* may, with time, begin to influence the manager and this in turn may influence events on the farm. If this occurs, the observer is in fact observing an artificially evolving situation and this should be avoided if possible. One way that the situation may be minimized is to limit feedback from the study to the collaborator. The inherent danger with this is that the collaborator may begin to lose interest in the project, particularly if the project is lengthy, and hence the quality of data that is provided to the study may deteriorate. To counteract this, considerable care was taken to explain to all volunteers that they would receive little direct feedback of results from the project. On the basis of this, some of the initial volunteers elected not to participate. Furthermore, an attempt was made to ensure that any feedback provided would have a minimal effect on farm performance. This was done by providing feedback, which while of benefit to the dairyman, was not directly related to the project, and by providing feedback which was for the most part summarized at the project, rather than the individual farm, level. An example of the former type of feedback was the provision of cow

TABLE II. Name and Definition of Conditions as Used in a Study of Southwestern Ontario Dairy Farms

Condition	Definition
LAME	any foot problem resulting in lameness
MUSCSKELOTHER	any limb problem, other than with the foot, or any other abnormality of the musculoskeletal system
RETICULUM	any abnormality of the reticulum, e.g. hardware
LDA	abomasum displaced on left side of body and surgery required for correction
INTEST	any condition of intestinal tract, included infectious and physical abnormalities
GITOTHER	any condition of the gastrointestinal tract not isolated to the reticulum or intestine
ABORT	a calf born dead before term
STILLBIRTH	a calf born dead at term
DIFFCALV	a calving which required veterinary assistance
RP	fetal membranes retained for more than 48 hours
METRITIS	any uterine infection requiring treatment
OVARY	any abnormal or cystic condition of the ovary
REPOTHER	any reproductive condition other than those detailed under RP METRITIS and OVARY above
MASTITIS	any clinical case of mastitis
MAMMOTHER	all injuries to teats and all abnormalities of the mammary gland other than mastitis
MILKFEVER	any clinical case of milk fever requiring treatment
KETOSIS	any clinical diagnosis of acetonemia and no other disease found during the same 24 hour period
RESP	any abnormality of the lower or upper respiratory tract
CNS	any abnormality of the central or peripheral nervous system
RENAL	any abnormality of the renal system
SKIN	any abnormality of the skin
EYE	any abnormality of the eye
GENERAL	any general specified condition, e.g. brucellosis, any general unspecified condition, e.g. off feed, any poisoning or any nutrient deficiency

level somatic cell counts to dairymen after each production test date. This was achieved by retrieving milk samples from the ODHIC laboratory and doing cell counts at the Ontario Veterinary College. This service was initiated with the commencement of the project and was terminated approximately one year later as a somatic cell counting service was then available from ODHIC.

TABLE III. Level of Production on 100 Southwestern Ontario Dairy Farms

Item	Year 1981	1982	1983
305 day milk[a] (kg)	6224.6[c] ± 609.5	6252.5 ± 678.6	6443.7 ± 728.3
Fat[a] (%)	3.6 ± 0.1	3.6 ± 0.1	3.6 ± 0.1
Protein[a] (%)	3.1 ± 0.1	3.1 ± 0.1	3.1 ± 0.1
BCA milk	130.3 ± 12.1	131.4 ± 12.4	134.7 ± 12.9
BCA fat	128.6 ± 11.5	129.8 ± 12.2	134.7 ± 13.4
Calving interval[b] (months)	13.2 ± 0.6	13.2 ± 0.6	13.2 ± 0.6

[a]Does not include 12 herds on Record of Performance
[b]Only available for the 34 "intensive herds"
[c]Mean and standard deviation

DATA STORAGE AND ANALYSIS

All data were entered and stored in computerized files. In the case of extensive herds, the technicians summarized the number of occurrences of each specific event before data entry. In order to synchronize the production and event data, all data were summarized to the most recent production program test date instead of the date of visit of the field staff. On intensive farms, production and event data were stored at both the individual animal and summarized herd level. The definition of the various disease conditions are presented in Table II.

A number of preliminary analyses have been completed. Many of these analyses include the calculation of a rate, often with animal-years of risk as the denominator. In all cases, unless otherwise specified, these rates are for mature, i.e. calved at least once, animals only. An animal in a herd for one year contributes one animal year of risk. Likewise, three animals each of which stayed in a herd for four months would also contribute one animal year of risk. This approach has been taken because herds started and stopped the project at different times and the use of calendar time would be confusing. In general, rates were calculated for each herd separately and then summarized across herds.

The usage of various antimicrobials and other products was calculated both as the number of series and doses. A series of treatments is an "episode" of treatment (doses) for a condition. Thus, the use of penicillin twice per day for three days would constitute one series and six doses. As well as antimicrobial specific rates, crude and adjusted rates were also calculated. The crude rates include any antimicrobial used for either therapeutic or prophylactic purposes, while the adjusted rates are restricted to therapeutic purposes only.

An attempt was made to quantify many aspects of the physical plant on each farm including the housing, access to outdoor exercise areas, feeding, milking and manure-handling systems. The relationships between the latter variables and each of the various measures of production, reproductive efficiency and disease occurrence were estimated using multiple linear regression.

RESULTS

GENERAL

By the end of the data collection phase of the project (summer of 1983) the number of participating dairymen was reduced to 34 intensive and 66 extensive farms (Table I). Approximately half of the farmers who dropped out of the project did so because of selling of their herd, or herd loss due to fire, while the other half did not wish to continue.

The average 305 day milk production increased gradually during the three calendar years from 6224.6 kg in 1981 to 6443.7 kg in 1983 (Table III). The average calving interval was stable at 13.2 months for all three years.

The majority of cows which were removed from the herds were culled for beef (0.243 per animal year). The next highest rate was for domestic sale, followed by death, export sale and destroyed (Table IV).

PHYSICAL PLANT SURVEY

Tie stalls were used in 82.7% of the project farms with 13.5% using free stalls. The tie stalls averaged 167.1 ± 10.5 (SD) cm in length and 116.1 ± 9.4 cm in width, and the free stalls averaged 227.0 ± 16.8 cm in length and 117.6 ± 5.6 cm in width. The majority of farms had cement flooring in their stalls (85.6%) and used straw for bedding (90.4%). High pipeline, low pipeline, dumping station and bucket milk collection systems were used by 82.7, 9.6, 4.8 and 2.9% of producers respectively.

In an initial analysis, only a small number of the physical plant characteristics examined explained any significant variation in production and disease occurrence on the farms. This could mean either that general plant characteristics do not significantly affect the rates of disease on farms or that the wrong characteristics were included or otherwise incorrectly quantified.

One finding of interest was that, as the hours of outdoor activity in summer increased, the use of drugs appeared to decrease. The rates of metritis, reproductive problems other

TABLE IV. Removal Rate[a], Based on Animal Years, of Cows from 100 Southwestern Ontario Dairy Farms

Removal Reason	Mean (%)	SD (%)
Beef (culled)	24.3	9.0
Domestic sale	3.9	8.2
Death	2.7	2.0
Export sale	0.5	1.3
Destroyed	0.3	0.6

[a]Includes both intensive and extensive herds. See text for explanation of calculation method

TABLE V. Percentage Adoption of Management Factors Associated with Mastitis Control on 100 Southwestern Ontario Dairy Farms, 1981

Management Factor	Percent Adoption
Use of teat dip	
no or occasional	31.4
all cows	68.6
Use of dry cow therapy	
no	10.8
selectively	41.2
all cows	48.0
Preparation of udder (washing)	
single use paper towel (or newspaper)	55.9
rag or sponge	34.4
other	9.7
Drying of udder before milking	
no	75.5
yes	24.5

than metritis, ovarian disorders and retained placenta also appeared to decline. The underlying biological explanation for this is not known at this time, but it could include the effect of sunlight on metabolism, and/or benefits resulting from increased exercise. More detailed results of this analysis have been previously reported (5).

MANAGEMENT SURVEY

The frequency of use of various management practices associated with each of mastitis and reproduction are presented respectively in Tables V and VI.

Teat dip and dry cow therapy were used regularly by most producers. Single use paper towels were used to wash the udder by 56% of the farmers and most did not dry the udder before milking.

As can be seen from Table VI, half the producers did not use vitamin D and most did not regularly use vitamin E and selenium in cows before calving. One half of the dairymen waited until after 60 days postcalving before starting to rebreed their mature cows. With respect to heat detection, it is noteworthy that 42% of the dairymen had no set period to observe estrus, and in about one third of the farms the majority of estrus detection was done once daily in the barn during periods other than milking.

Routine pregnancy diagnosis was conducted on about 90% of the farms and approximately 80% had a veterinarian conduct routine postcalving reproductive examinations.

TABLE VI. Percentage Adoption of Management Factors Related to Reproduction on 100 Southwestern Ontario Dairy Farms, 1981

Management Factor	Percent Adoption
Use of vitamin D before calving	
no	51.0
cows with milk fever history	24.5
all older cows	18.6
all cows	5.9
Use of vitamin E and Se before calving	
no	73.5
selectively	11.8
all cows	14.7
Use of oxytocin to aid expulsion of placenta	
no	70.6
selectively	25.5
all cows	3.9
Onset of rebreeding mature cows	
prior to 60 days postcalving	46.1
more than 60 days	53.9
Number of heat detection periods per day	
no set period	42.2
one period	32.4
two periods	17.6
three periods	7.8
When heat detection is done	
during milking	13.7
in barn other than during milking	36.3
during exercise	29.4
other	20.6

DISEASE RATES

The rates of occurrence of disease syndromes are presented in Table VII. The highest rate, for those conditions whose rates were based on calving, was retained placenta (0.09/calving), while clinical mastitis was highest for those conditions whose rates were based on animal years (0.37/animal year).

ANTIMICROBIAL AND OTHER PRODUCT USAGE RATES

As can be seen from Table VIII, the overall crude antimicrobial dosage rate (that is, including any antimicrobial used for either prophylactic or therapeutic purposes), was 3.85 doses per animal year. The rate for therapeutic purposes only was 3.6 doses per animal year. For both measures, there was considerable variation, as indicated by the standard deviation, and the usage on the farm with the highest rates was approximately 3.0 times higher than the mean. Penicillin/streptomycin was used most often with a rate of 1.45 doses per animal year. The crude and adjusted dose rates are approximately 2.5 times that of the respective series rates for the more frequently used antimicrobials.

TABLE VII. Rate of Disease Occurrence on 100 Southwestern Ontario Dairy Farms

Disease[a]	Mean (%)	SD (%)
Based on Calvings		
RP	8.6	5.9
MILKFEVER	7.5	4.8
DIFFCALV	2.8	2.6
LDA	1.7	1.9
Based on Animal Years		
MASTITIS (clinical)	36.5	25.7
REPOTHER	23.1	38.1
METRITIS	19.4	22.9
OVARY	8.1	8.1
MAMMOTHER	7.6	9.6
LAME	6.7	7.4
GENERAL	6.5	8.0
KETOSIS	5.0	7.0
STILLBIRTH	3.7	2.8
RESP	2.6	3.4
ABORT	2.2	1.9
INTEST	2.1	3.4
GITOTHER	1.3	1.8
RETICULUM	1.2	1.5
MUSCSKELOTHER	1.0	1.3
EYE	0.5	1.5
SKIN	0.4	1.5
RENAL	0.1	0.4
CNS	0.1	0.2

[a]See Table II for definitions. Includes both intensive and extensive herds

This indicates that 2.5 treatments (doses) were given to each cow requiring antimicrobial treatment (i.e. each series).

Of the antimicrobial series administered for therapeutic purposes, 54.4% were given for mastitis, 13.5% for metritis, 8.5% for retained placenta, 6.6% for general unspecified conditions and 4.1% for respiratory disease with lesser percentages given for the other conditions (Table II). Of the penicillin/streptomycin series given, 61.6% were for mastitis and 3.7, 10.0, 5.1 and 2.5% were utilized respectively for metritis, retained placenta, general and respiratory conditions. With respect to chloramphenicol, 66.6% of the treatments were used for mastitis with 0.8, 3.0, 11.3 and 7.6% used respectively for the other four conditions. Regarding tetracycline, 51.0% of the treatments were used for mastitis with 27.7, 3.4, 5.7 and 5.8% being used respectively for metritis, retained placenta, general and respiratory conditions.

The rates of usage, based on animal years for each of vitamins/minerals and hormones are presented in Table IX.

The results of the analyses performed on the water samples are presented in Table X. Water from drilled wells was more alkaline and contained more nitrates, but less calcium and magnesium, than water from nondrilled wells.

TABLE VIII. Mean Number of Antimicrobial Doses and Series, used for Both Prophylactic and Therapeutic Purposes, per Animal Year on 34[a] Southwestern Ontario Dairy Farms

	Doses			Series		
Item	Mean	SD	Maximum[b]	Mean	SD	Maximum
Penicillin/ Streptomycin	1.45	0.85	3.53	0.50	0.31	1.14
Chloramphenicol	1.03	1.02	4.74	0.29	0.25	1.00
Tetracycline	0.56	0.91	3.77	0.20	0.26	1.07
Cloxacillin	0.19	0.26	1.28	0.15	0.18	0.72
Antimicrobial Mixture	0.12	0.39	2.20	0.04	0.13	0.71
Hibitane[c]	0.11	0.27	1.25	0.03	0.05	0.19
Furasone	0.07	0.08	0.36	0.06	0.06	0.25
Neomycin	0.06	0.09	0.40	0.04	0.09	0.40
Iodine	0.05	0.10	0.32	0.05	0.10	0.32
Antimicrobial (no details)	0.05	0.05	0.21	0.04	0.04	0.14
Sulphonamide	0.05	0.09	0.43	0.02	0.04	0.17
Trivetrin[c]	0.04	0.09	0.39	0.01	0.02	0.09
Erythromycin	0.03	0.14	0.78	0.01	0.05	0.26
Tylocine	0.02	0.07	0.29	0.003	0.01	0.06
Gentamycin	0.01	0.04	0.19	0.01	0.02	0.07
Ampicillin	0.003	0.01	0.07	0.001	0.004	0.02
Total usage (crude)	3.85	2.47	11.77	1.45	0.78	3.26
Total usage (adjusted)[d]	3.60	2.41	11.42	1.21	0.71	3.00

[a]Includes intensive herds only
[b]Rate on farm with highest usage
[c]Hibitane and Trivetrin are registered trade names of Ayerst Laboratories and Coopers Agropharm, respectively
[d]Adjusted to remove antimicrobials used prophylactically

DISCUSSION

The project outlined was designed to include a data collection, data analysis and model development phase. The data collection phase is now complete. The data analysis phase has been ongoing for some time and will continue for a few more years. The model development phase is just beginning. The purpose of this paper is to present the nature and scope of the project, and to present some of the initial descriptive results.

In projects of this nature, there is usually no alternative other than to work with volunteers. In this study, project herds had slightly higher production than the average for all Ontario ODHIC producers. For example, the 1981 ODHIC provincial BCA average milk production was 128 compared to 130 for the project farms for the same period. Nevertheless, given the constraints of the project, it is felt that the selected herds were reasonably representative of Ontario dairy enterprises.

The overall culling rate (beef) in the

TABLE IX. Mean Number of Doses and Series of Vitamins/Minerals and Hormones used per Animal Year on 34[a] Southwestern Ontario Dairy Farms

Item	Doses			Series		
	Mean	SD	Maximum[b]	Mean	SD	Maximum
Vitamins and Minerals:						
Vitamins ADE	0.17	0.28	1.21	0.08	0.14	0.56
Calcium, Phosphorus, Magnesium	0.18	0.15	0.78	0.13	0.12	0.66
Vitamin E and/or Selenium	0.04	0.13	0.74	0.04	0.13	0.74
Vitamin B Complex	0.04	0.07	0.23	0.02	0.05	0.23
Vitamin D	0.05	0.08	0.40	0.05	0.08	0.39
Other	0.03	0.08	0.33	0.01	0.03	0.13
Hormones:						
GnRH	0.10	0.10	0.34	0.10	0.09	0.34
LH	0.02	0.04	0.18	0.01	0.02	0.08
Estrogen	0.01	0.03	0.14	0.01	0.03	0.14
Oxytocin	0.04	0.07	0.33	0.03	0.07	0.33
Progesterone	0.04	0.12	0.64	0.04	0.12	0.64
Prostaglandin	0.15	0.15	0.65	0.15	0.15	0.65
Other	0.01	0.04	0.21	0.003	0.01	0.02

[a]Includes intensive herds only. See text for explanation
[b]Rate on farm with highest usage

TABLE X. Results of Water Analyses Conducted on Dairy Farms in Southwestern Ontario, 1981

Element	Results					
	Number[a]	Mean	SD	Median	Maximum	Minimum
Sodium (mg/L)	103	18.85	17.37	12.50	91.0	1.00
Calcium (mg/L)	102	63.92	32.10	58.00	224.0	7.00
Magnesium (mg/L)	102	25.48	9.37	24.00	74.0	8.00
Hardness	71	281.04	127.82	260.00	865.0	84.00
PH	103	7.80	0.22	7.80	8.3	7.30
Sulfate (mg/L)	103	49.85	96.83	22.00	700.0	1.00
Nitrate (mg/L)	103	1.75	4.35	0.09	29.5	0.05
Iron (ppm)	103	0.37	0.73	0.10	4.7	0.01
Manganese (mg/L)	103	0.25	0.05	0.01	0.4	0.00

[a]Number of farm water samples

present study was 0.243 per animal year. This rate is higher than that reported in recent studies by Dohoo (6) and Westell *et al* (7). Some of this difference might be explained by the different calculation methods used. As well, the present study had a lower removal rate for reasons of domestic and export sale. This would suggest that the dairymen in the present study, because of lower opportunity sales, were heavily culling their herds.

The rates of adoption of several mastitis control techniques are higher than those found by Meek *et al* (8) in a survey conducted in 1978. Specifically, 68.6% (vs 54%) of the present producers used teat dip regularly, 48.0% (vs 37%) used dry cow therapy for all cows at drying off and 55.9% (vs 51.6%) used a single use towel (or newspaper) to prepare the udder before milking.

When comparable, the rate of occurrence of the commonly recorded diseases are in general agreement with those reported by Dohoo (6). The two most notable exceptions were that the present study reported a higher rate of clinical mastitis and a lower rate of ovarian problems than did Dohoo. Some of this difference may be attributable to the fact that the present study based rates on animal years, while Dohoo used lactational rates. In both cases, the two most commonly occurring problems were those related to either the reproductive tract or the mammary gland.

The overall dose rate of antimicrobial usage for therapeutic purposes was 3.84 doses per animal year. In effect, this implies that on average, a mature cow during the course of one year received approximately four treatments with an antimicrobial. It is possible that these estimates may be conservative as it is more likely that antibiotics were used and not recorded than the reverse situation. With respect to antimicrobial usage rates, no directly comparable studies could be found. Further analysis of antimicrobial and other product usage rates will be conducted to determine if these rates are associated with the average age of cows and the herd level of production, and will attempt to determine reasons for the variation in usage from herd to herd.

ACKNOWLEDGMENTS

We are grateful for the support of the Ontario Ministry of Agriculture and Food through their Provincial Lottery Research Awards Program, to the Ontario Milk Marketing Board and to the Ministry of the Environment. Our appreciation is also extended to the many dairy farmers involved with the study, and to Marg Montgomery, Karen Earle, Brian Cameron and Heather Bailey for their technical assistance.

REFERENCES

1. **SPEDDING CRW.** An introduction to agricultural systems. London: Applied Science Publishers, 1979.
2. **BIGRAS-POULIN M, MEEK AH, BLACKBURN DJ, MARTIN SW.** Attitudes, management practices, and herd performance — A study of Ontario dairy farm managers. I. Descriptive aspects. Prev Vet Med 1984a; 3: 227.
3. **BIGRAS-POULIN M, MEEK AH, MARTIN SW, McMILLAN I.** Attitudes, management practices, and herd performance — A study of Ontario dairy farm managers. II. Associations. Prev Vet Med 1984b; 3: 241.

4. **WILLIAMS NTR.** The effect of feed and feeding management on production and disease occurrence in Holstein herds. MSc Thesis, University of Guelph, Guelph, Canada. 1982.
5. **MEEK AH, MARTIN SW, STONE JB, McMILLAN I, BRITNEY JB.** Factors associated with productivity and disease occurrence in Ontario dairy herds. Proceedings Third International Symposium on Veterinary Epidemiology and Economics, Washington, D.C. 1982.
6. **DOHOO IR.** An epidemiological study of disease, production and culling in Holstein-Friesian cows. PhD thesis. University of Guelph, 1982.
7. **WESTELL RA, BURNSIDE EB, SCHAEFFER LR.** Evaluation of Canadian Holstein Friesian sires on disposal reasons of their daughters. J Dairy Sci 1982; 65: 2366.
8. **MEEK AH, GOODHOPE RG, BARNUM DA.** Bovine mastitis: A survey of Ontario dairy producers, 1978. Can Vet J 1981; 22: 46.

BOOK REVIEW

ANIMAL STRESS. *Edited by Gary P. Moberg. Published by Williams & Wilkins, Easton, Maryland. 1985. 324 pages. Price US$42.50.*

This is a very good book. Stress is a difficult subject to cover in a succinct manner since there are multiple modes of response. This multi-author text admirably summarizes neurological, endocrine and metabolic responses made by animals to stress situations. Just as beauty is in the eye of the beholder, so stress is in the perception of the individual. The importance of an awareness of stress is well delineated and involves the humane treatment of animals as well as proper experimental protocols. It is a subject of concern to all practicing veterinarians.

The opening chapter by Curtis is excellent, relating animal well being, needs, perceptions and preferences. The possible determinants of stress and how they may be monitored follow in successive chapters. Findings that greatly extend the hypothesis of Selye are well presented, emphasizing the variability of response by different body systems. Of particular significance are several chapters on the relationship between stress and the immune system. The outline by Kelly is a good summary in this regard and indicates the role of stress with opportunistic, avirulent infectious agents in disease causation. The book ends with two chapters on guidelines for animal care (American) and on laboratory animal environmental conditions. This book will appeal to all those with a concern for animal welfare and health.

R.M. Liptrap.