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Farming practices associated with the 'udder infection' complex

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Summary — A total of 4 129 dairy cows from 47 dairy farms were submitted each year after calving to a milk sampling for bacteriological examination. Six critera defined the udder infection complex: frequency of minor, major and rare pathogens; rate of clinical and subclinical mastitis; and index of gravity of mastitis. Forty-seven variables described practices and their associations with the type of farms (defined by the above 6 criteria) were studied. The associated variables were dipping practices, covering of the milking parlour, disinfection practices, housing cleanliness and milk production.

epidemiology / mastitis / milk production / farming practices / milk quality

Résumé — Pratiques d'élevage associées au complexe «atteinte de la mamelle». *Provenant de 47 élevages laitiers, 4 129 vaches ont subi annuellement un prélèvement de lait après vêlage pour examen bactériologique. Six critères définissaient le complexe «atteinte de la mamelle» : taux de pathogènes mineurs, majeurs, rares, taux de mammites cliniques, subcliniques et gravité des mammites. Quarante-sept variables décrivant des pratiques ont été retenues et les liaisons entre les variables et les types d'élevage définis à partir des 6 critères ci-dessus ont été étudiés. Les variables associées significativement étaient le type de trempage, le revêtement de la salle de traite, la désinfection, la propreté et la production laitière.*

épidémiologie / mammite / production laitière / pratique d'élevage / qualité du lait

INTRODUCTION

The large and regular increase in milk production in the past decades does not necessarily mean an improvement in udder health. Mastitis constitutes the most frequent clinical disease in dairy cattle. Incidence rates, particularly in France, still range between 20 and 30%. In the present study, a multicriteria approach of the milk sanitary quality was undertaken to determine a farm profile according to different parameters defining udder health and milk production.

* Correspondence and reprints

MATERIALS AND METHODS

Data were collected from the database constituted after a 4-yr ecopathological survey in Brittany (France) in 47 intensive dairy herds (Faye *et al*, 1989). A total of 4 129 dairy cows (8 945 lactations) were recorded. Clinical mastitis was described according to the clinical signs and the identification of the infected quarters. Computerized data from milk recordings gave information about somatic cell counts (SCC) and milk production. Farm data (housing, milking practices, sanitary conditions, feeding), were collected on the basis of a monthly report. For each lactation, a bacteriological analysis was performed on 1 milk sample collected before the seventh week of lactation. A total of 7 852 milk samples were analyzed. Only pathogens were identified.

Definition of variables

Six criteria were used to define the sanitary quality of milk and 'udder infection' complex. For each herd and reference annual period, these were: rate of milk records with major (GMAJ), minor (GMIN) and rare pathogens (GRAR); rate of clinical mastitis within the first 2 months of lactation (MAM); rate of high SCC (> 4 x 10^5 cells/ml) in the first 2 milk recordings of each lactation (LEUC); and average index of mastitis gravity (GRAV) calculated as:

$$GRAV = [(M \times g) \times (Q)]/n$$

where M is the number of cows lactations infected with mastitis during the first 2 months of lactation; g is the seriousness of mastitis (1: modification of milk or inflammation only, or not specified; 2: modification of milk and inflammation; 3: general signs; 4: gangrenous); Q is the number of quarters infected; and n is the number of cows recorded.

Each of the variables was classified using 3 levels (18 modalities).

Explanatory variables

Forty-seven variables were used in the model. These variables were qualitative. They described farm data: farmer's characteristic; housing; milking parlour; milking practices; feeding level; and health disorders. Correlations between variables were tested to eliminate redundancies.

Statistical analyses

The farm-year was the statistic unit (n = 187). It was described by the modalities of the variables to be explained. Multifactorial correspondence analysis and ascending hierarchical clustering were used to determine categories of similar farms according to variables to be explained. The classes resulting from the clustering procedure constituted the different types of farms to be tested using the explanatory variables, firstly 2 by 2, then in a multiple correspondence analysis model, taking associated variables.

RESULTS

Farm typology

The main factorial plan (1,2) showed a gradient of the rate of clinical mastitis related to the gradient of the SCC (LEUC), and major pathogens (GMAJ), and index of seriousness (GRAV). Rare pathogens were projected according to a reverse gradient and GMIN were badly represented and projected near the centre of gravity (fig 1). Six groups (farm types) were well identified. The mean levels of the 6 original variables in the groups are reported in table I.

Associated variables

Five variables were significantly associated with the 6 different farm types: dipping practices; covering of the milking parlour; disinfection practices; housing cleanliness; and milk production. Eight other variables were non-significantly associated, but with a probability of less than 10%: housing type; the

Table I. Rate (%) of different parameters of the 'udder health complex' according to type of farms.

	Group of farms (n)					
	1 (16)	*2 (22)*	*3 (30)*	*4 (37)*	*5 (42)*	*6 (40)*
Variables (significance level)						
GMIN (ns)	24.6	63.1	39.2	26.8	54.6	37.4
GMAJ ($P < 0.0001$)	16.8	27.6	16.7	16.1	8.4	11.1
GRAR ($P < 0.03$)	2.3	0.1	2.0	2.9	2.2	3.2
MAM ($P < 0.001$)	28.7	19.1	13.2	18.3	6.7	10.1
LEUC ($P < 0.001$)	37.1	35.6	23.7	27.1	17.0	16.8
GRAV ($P < 0.001$)	14.3	3.2	2.8	4.8	1.1	1.4

For abbreviations see figure 1.

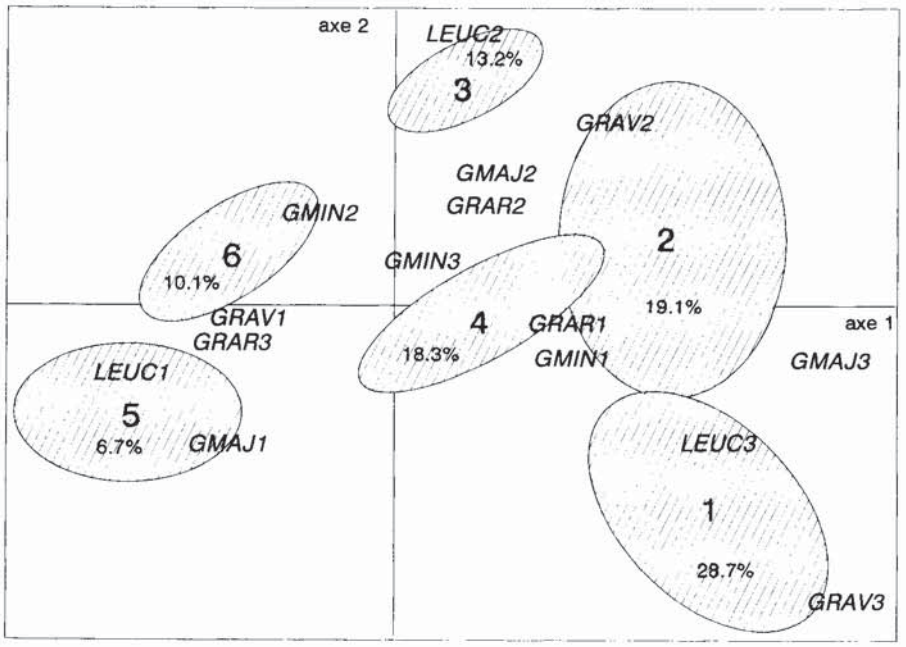

Fig 1. Main factorial plan (1, 2) from multiple correspondence analysis, which explains 28.1% of total variance. LEUC: high SCC (> 4 x 10^5 cells/ml); GMAJ: rate of milk records with major pathogen; GMIN: rate of milk records with minor pathogen; GRAR: rate of milk records with rare pathogen; MAM: rate of clinical mastitis within the first 2 months of lactation; GRAV: average gravity index of mastitis.

time that the farmer has been practicing; intensification on a high technical level; the type of milk-ending system; quarantine for animals; the type of feeding system; spreading of superphosphates; the fattening score after calving; and the control of the milking machine. These were included in the final model and compared within the 6 groups after a factorial analysis.

Group 1: high rate of mastitis, low germ count

The farmers had recently started intensification. They used a loose housing system with a high animal density. New animals were not isolated. The cleanliness score was bad. The cows were rather fat after calving. Trough feeding was used. Superphosphates were spread on the litter. The milking parlour was covered with whitewashed concrete, and there was no milking-ending system.

Group 2: high rate of mastitis, high germ count

Farmers in this group had been practicing on a highly technical level for a long time; they had a room to isolate animals, and a loose housing system. The cleanliness score was good, but the cows were rather thin and were fed at troughs. There was regular control of the milking machine and desinfection. The milking parlour was covered with rough concrete and there were wet patches. The dipping product contained iodine. There was no milking-ending system.

Group 3: intermediate group

Few explanatory variables were significantly linked to this group. Farmers had been practicing on a moderately technical level. They disposed of a loose housing system. The cleanliness score was rather good. The cows were fed at a silo.

Group 4: transition group

This group was distinguished from Group 3 by higher incidence rate of mastitis, SCC, and lower germ counts, and its characterization was difficult. Farmers disposed of an open cubicle housing system with the necessary housing appliance for animals. The cows were fed at silos; there was no disinfection. The dipping product contained neither iodine nor chlorine; the milking parlour was paved.

Group 5: low rate of mastitis, high rate of minor germs

In this group, the cows disposed of a closed cubicle housing system and a quarantine room for new animals. The milking parlour was paved. The washing product contained chlorine. There was no milking-ending system. Farmers did not spread superphosphates over the litter and did not control the milking machine.

Group 6: low rate of mastitis, low germ counts except for rare germs

In this group, the farmers had been practicing on a highly technical level for a long time. Cows disposed of a cubicle housing system with a rather good cleanliness score. There were no indoor wet patches. The cows had a moderate fattening score and were fed at feeding table. No new heifers entered the herd. The farmers did not practice dipping or only used products without chlorine and iodine.The milking parlour was generally built of whitewashed concrete.

DISCUSSION

A rich literature deals with associations between production factors, milking prac-

tices, and other criteria defining the quality of milk or udder health. Many variables were generally tested, but it can be considered that multifactorial influences act on the udder health in different ways (Goodger *et al,* 1993). Risk factors for intramammary infections (IMI) were different according to the kind of pathogens implicated. Moreover, risk factors for clinical and subclinical mastitis were not always the same. The present study showed that few environmental parameters are linked to farm typology. Teat dipping is generally considered as an efficient practice, but its efficiency was supposed to be more important for SCC than for IMI (Lindström, 1983). Even if dipping products helped decrease the incidence rate of IMI experimentally, good milking practices were necessary (Boddie *et al,* 1993). Furthermore, several variables (disinfection of the milking parlour, control of the milking machine, spreading of superphosphates) generally considered as health factors appeared to be associated with a rather less favorable sanitary status. These results, and those from other epidemiological surveys (Schukken *et al,* 1990a), deal with the problems linked to the status of variables. These variables were indicators of the farmer's decision-making in case of a mastitis problems rather than risk factors. The general hygiene, tested in this study by a cleanliness score (Faye and Barnouin, 1985), was very discriminant, according to many results (Francis, 1984; Barlett *et al,* 1992). The litter thus had an important role (Schukken *et al,* 1990b; Hutton *et al,* 1991). Moreover, the presence of indoor wet places in rest areas or passages had to be taken into consideration as risk factor (Serieys, 1985). Several studies have indicated the importance of straw bedding (Faye and Brochart, 1986; Schukken *et al,* 1990b). The coating of the milking parlour was dependent on the same analysis: cleaning was easier in paved areas, or on whitewashed concrete, then in irregular and non-treated areas. The type of housing, related to the animal density was also discriminant. Cubicle housing systems were more favourable. But, finally, the farmer's knowledge was more significant. The best producers controlled the diet balance, raised heifers, and had a good technical level for a long time and presented the most favorable results.

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Facteurs nutritionnels et inflammation-infection mammaire chez la vache laitière. Approche écopathologique dans la période du *peripartum*

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Résumé — Une étude des relations, chez la vache laitière, entre la nutrition et les processus inflammatoires de la mamelle a été entreprise par une approche écopathologique. L'étude avait pour cadre l'enquête écopathologique Bretagne, conduite durant 4 années en France sur des troupeaux à haut potentiel laitier. Une nutrition de début de lactation, comportant une importante durée de distribution d'ensilage de ray-gras italien et une faible quantité de concentrés à base de céréales, était reliée à de faibles taux leucocytaires dans le lait (probablement en relation avec un haut niveau énergétique ou une moindre synthèse de leucotriènes). Une ration de fin de gestation basée sur le ray-grass anglais en vert et induisant de fortes urémies, et incluant par ailleurs une large distribution de vitamines A, D et E, était reliée à une fréquence plus faible de germes pathogènes majeurs dans le lait.

écopathologie / vache / infection mammaire / nutrition / acide gras polyinsaturé

Summary — Nutritional factors for udder inflammation and infection in the dairy cow. *The relationships between nutrition and udder inflammation/infection were studied in the dairy cow using an ecopathological approach. The study ('enquête écopathologique Bretagne') was performed over 4 yr in French herds with high-lactating cows. A long distribution time of Italian rye-grass silage and a low quantity of dietary cereal-based concentrates in the first 2 months of lactation was linked with low milk leukocyte counts, probably due to a high dietary energetic level or to a polyunsaturated fatty acid imbalance and a subsequent decrease in the synthesis of leukotriene LTB4. In the late gestation period, a long distribution time of fresh English rye-grass, which induced high uraemia and a larger distribution of vitamins A, D and E, was related to lower frequencies of major pathogens in the milk.*

ecopathology / cow / udder infection / nutrition / polyunsaturated fatty acid

* Correspondance et tirés à part.