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Characteristics of dairy farms in the North-Eastern part of Italy: rations, milk yield and nutrients excretion

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ABSTRACT - This survey was aimed to evaluate the characteristics of dairy farms in the North-Eastern part of Po valley in terms of ration composition, milk yield and N and P excretions. Eighty-nine farms, with Italian Holstein Friesian cows, were selected in order to cover different situations in term of farm size and milk yield (MY). MY and quality were obtained from the national database of functional controls. Each farm was visited in order to collect information about ingredients and chemical composition of rations used. Farms were classified in four groups differing for dietary crude protein density (L_{CP}<15.3% DM; H_{CP}>15.3% DM) and for MY (L_{MY}<30 kg/d; H_{MY}>30 kg/d). N and P excretions were quantified by following a mass balance approach. Dietary crude protein content (CP) was not correlated to milk yield (MY) and quality. The estimated amounts of N excreted, discounted for 28% of N losses in atmosphere, were 78.5, 78.2, 87.2 and 89.1 kg/cow/year, and P excreted were 20.2, 18.6, 18.7 and 19.8 kg/cow/year for the $L_{CP}L_{MY}$, $L_{CP}H_{MY}$, $H_{CP}L_{MY}$, $H_{CP}H_{MY}$ groups, respectively. On corn silage and cereals based rations, a dietary CP of 14.3% DM can support 31 kg MY/cow/day.

Key words: Dairy farms, Rations, Milk quality, Milk yield, Nitrogen excretion.

Introduction – The recent Ministerial Decree n. 152/2006 of MIPAF (2006) fixed, for Italy, standard values of N in manure for different animal categories; for dairy cows a value of 83 kg N/cow/year was stated. Since considerable variations are expected according to diet composition and milk yield, the Veneto Region allowed the farmers to evaluate N excretion of their farms, by following a mass balance approach (Schiavon *et al.*, 2007). The present survey was aimed to process information about the characteristics of a representative sample of farms in the region with regard to diet characteristics, milk yield and quality, milk urea N content and N and P excretions.

Material and methods – Eighty-nine dairy farms, with Holstein Friesian cows, located in the North-Eastern part of Po valley (Veneto, Italy) were randomly selected from the database of the National Farmers Association (AIA, 2006). Farms with average milk yield (MY) < 20 kg/cow/day were excluded. Data were collected from January to December 2006 by a single skilled operator and regarded feed and chemical composition of rations (all farms adopted total mixed rations), average MY, protein and milk fat contents (data from official functional controls, AIA 2006) and bulk tank milk urea N (MUN). Chemical compositions of rations were computed from ingredient compositions, using tabled values for concentrates (INRA, 2004), label information for commercial feeds and chemical analysis for forages. Samples of forages from the various farms were analyzed for proximate composition (AOAC, 1990), NDF and ADF fractions (Van Soest *et al.*, 1991). Dry matter intake (DMI) was estimated on annual basis as: $365*0.052*LW^{0.75}+0.5MY*DIM$; where LW is live weight (LW=620 kg) (ERM, 2001). DIM

Table 1. Characteristic of farms and milk yield and quality.

Group		$L_{CP}L_{MY}$	$L_{CP}H_{MY}$	$H_{CP}L_{MY}$	$H_{CP}H_{MY}$	SE
Farms	n.	27	8	18	36	-
Farms in vulnerable zone	%	59	75	56	69	-
Cows	cows/farm	36	31	62	58	14.0
Cows/unit of farm agricultural land	cow/ha	2.6	2.2	1.8	2.2	0.2
Milk yield	kg/cow/d	26.5^{A}	31.3^{B}	26.4^{A}	33.7^{B}	0.6
DM intake (estimated on annual basis)	kg/d	20.5^{AB}	20.9^{AB}	19.9^{A}	21.6^{B}	0.3
Milk fat	%	3.81	3.70	3.72	3.71	0.05
Milk protein	"	3.31	3.29	3.32	3.29	0.02
MUN[1]	mg/dL	10.54^{A}	11.03^{AB}	11.82^{B}	12.56^{B}	0.30
DIM[2]	d/year	303	306	308	309	4

A,B,C=P<0.01; [1]Milk Urea Nitrogen; [2] DIM=average days in milk per year and per cow.

is the number of days in milk. N consumption (NC) was computed from the estimated DMI and its N content. For the dry period a dietary CP content of 11.8% DM was assumed. N retention (NR) was estimated from MY and its N content, plus 1.9 kg of N due to the retentions of the newborn calf and of cow LW change from first parturition to culling (ERM, 2001). N excretion was achieved as NC-NR, and N in manure (N net) was computed by discounting the excreted N for 28% of losses in atmosphere (MIPAF, 2006). For the statistical analysis farms were classified in four groups: *i*) $L_{CP}L_{MY}$: CP<15.3% DM and MY<29.8 kg/cow/d; *ii*) $L_{CP}H_{MY}$: CP<15.3% DM and MY>29.8 kg/cow/d; *iii*) $H_{CP}L_{MY}$: CP>15.3% DM and MY<29.8 kg/cow/d; *iv*) $H_{CP}H_{MY}$: CP>15.3% DM and MY>29.8 kg/cow/d. Data were submitted to ANOVA using the proc GLM of SAS (2004). Differences among groups were assessed by orthogonal contrasts.

Results and conclusions – The proportion of farms with low MY and low dietary CP density was 30% (Table 1). About 9% of the sample was represented by farms with high MY and low dietary CP density. A considerable proportion of farms (20%) used high CP level with low MY. Over 56% of the farms were located in vulnerable zone. The average load of cow per hectare of agricultural land ranged among groups from 1.8 to 2.6. Significant differences of MUN (on average 8.4 analysis/farm/year) were found (P<0.01): it averaged 10.8 mg/dL in the low protein groups and 12.2 mg/dL in the high protein groups. These values are close to the 11 mg/dL suggested by Hof *et al.* (1997) for ensuring a correct balance between energy and protein in the rumen.

On average, more than 29% and about 22% of the ration DM was represented by corn silage and cereals, respectively (Table 2). Hays inclusion (mainly meadow and alfalfa) ranged from 24 to 21% DM. The proportion of mixed feed (from commercial and farm origin) averaged 12.2%, a higher proportion (21.7%) was found for $L_{CP}H_{MY}$ group, but the difference among groups was not significant.

Table 2. Feed and chemical composition of rations (% DM).

Group		$L_{CP}L_{MY}$	$L_{CP}H_{MY}$	$H_{CP}L_{MY}$	$H_{CP}H_{MY}$	SE
Ingredients:						
Corn silage	%	33.4^{B}	31.8^{AB}	29.9^{AB}	28.9^{A}	1.3
Cereals	"	21.6^{b}	14.3^{a}	23.1^{b}	22.7^{b}	1.9
Soybean	"	7.4^{A}	7.9^{A}	12.1^{AB}	14.0^{B}	1.7
Hays	"	24.4^{b}	23.7^{ab}	23.0^{ab}	21.0^{a}	1.3
Mixed feed	"	13.0	21.7	11.0	12.6	3.4
Others	"	0.2^{a}	0.6^{ab}	0.9^{b}	0.8^{b}	0.1
Chemical composition:						
Crude Protein	% DM	14.2^{A}	14.5^{A}	15.9^{B}	15.9^{B}	0.1
UFL[1]	n/kg DM	0.91^{A}	0.94^{AB}	0.96^{B}	0.97^{B}	0.01
Starch	% DM	24.3	23.8	24.2	25.1	0.4
NDF	"	36.6^{B}	35.7^{B}	33.6^{A}	33.3^{A}	0.4
ADF	"	21.9^{b}	21.8^{ab}	21.3^{ab}	20.9^{a}	0.3

A,B,C=P<0.01; a,b,c=P<0.05; [1]UFL: feed unit for milk production as indicated by INRA (2004).

The dietary CP level found in $H_{CP}L_{MY}$ and $H_{CP}H_{MY}$ groups averaged 15.9% DM, in the others two groups was 14.3% DM. Notwithstanding the different CP level, no significant differences of MY were found between $H_{CP}H_{MY}$ and $L_{CP}H_{MY}$. N and P balances are given in Table 3. N net averaged 84.3 kg/cow/year, close to the standard of MIPAF (2006).

Table 3. N and P balances and number of cows and MY corresponding to 170 kg N in manure/year.

Group		$L_{CP}L_{MY}$	$L_{CP}H_{MY}$	$H_{CP}L_{MY}$	$H_{CP}H_{MY}$	SE
N consumption	kg/year	153.1 ^{C}	160.0 ^{BC}	166.1 ^{B}	179.9 ^{A}	4.5
N retention	"	44.5 ^{A}	51.4 ^{B}	44.7 ^{A}	55.7 ^{B}	0.9
N excretion	"	109.0 ^{A}	108.6 ^{AB}	121.0 ^{BC}	123.8 ^{C}	3.4
N net[1]	"	78.5 ^{A}	78.2 ^{AB}	87.2 ^{BC}	89.1 ^{C}	2.3
N efficiency	%	29.2 ^{B}	32.4 ^{B}	26.9 ^{A}	31.0 ^{B}	0.8
P consumption	kg/year	29.3	29.3	28.0	31.3	1.5
P retention	"	9.1 ^{A}	10.6 ^{B}	9.3 ^{A}	11.5 ^{B}	0.2
P excretion	"	20.2	18.6	18.7	19.8	1.5
P efficiency	%	32.6 ^{A}	37.6 ^{AB}	34.1 ^{AB}	37.9 ^{B}	1.9
Cows equivalent to 170 kg N net/year	cow/170 kg N	2.2 ^{B}	2.2 ^{B}	2.0 ^{AB}	1.9 ^{A}	0.1
MY corresponding to 170 kg N net	kg/kg	58.5 ^{A}	69.5 ^{B}	51.8 ^{A}	64.8 ^{B}	2.1

A,B,C=P<0.01; [1]N in manure assuming 28% of total N lost in the atmosphere.

Significant differences (P<0.01) among groups were observed for N net which averaged 78.5, 78.2, 87.2 and 89.1 kg/cow/year for $L_{CP}L_{MY}$, $L_{CP}H_{MY}$, $H_{CP}L_{MY}$ and $H_{CP}H_{MY}$ group, respectively. N efficiency ranged from 26.9 to 32.4%. P in manure ranged from 18.6 to 20.2 kg/cow/year. No significant correlations were found between CP level and MY or milk protein content. A significant correlation was found between dietary CP and N excretion (R^2=0.37). The low correlation between bulk tank MUN and N net (R^2=0.07) indicated that the measurement of MUN alone cannot be used as a tool for predicting the excretions. The number of cows and MY corresponding to 170 kg N net/ha/year ranged from 1.9 to 2.2 (P<0.01) and from 51.8 to 69.5 kg/ha/year (P<0.01). In conclusion, the main feed ingredients used in the rations were corn silage and cereals. Hays represented only about 20% of the ration DM. The average CP content of the ration was 15%, a value considerable lower than that reported for similar level of MY in other conditions (ERM, 2001; ADAS, 2007). The estimated N in manure averaged 84 kg/cow/year, but for about 30% of the farms the estimated N in manure was significantly lower. Dietary CP levels around 14.5% DM can support MY of 31 kg/cow/d.

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