

ALPINE FARM SCALE INVESTIGATIONS OF THE RELATIONSHIPS BETWEEN PRODUCTIVE SYSTEM AND QUALITY OF DAIRY PRODUCTS

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SUMMARY

Alpine dairy farming is shifted from an extensive activity based on pasture and low genetic merit cow to an intensive system with specialized breeds and increasing level of concentrate as a supplement in the diet. As a main consequence, a lower eco-compatibility could determine adverse externalities on environment and quality of dairy products. Considering 18 dairy farming located in the mountain area of Veneto Region (Italy), the Environmental Summarizing Indicator (ESI) was estimated by using agronomic and dairying variables. Results indicated that variability of ESI was mainly due to productive performance of dairy cows probably because there was a lack of information in the assessment of pasture characteristics. However, higher level of ESI were closely related to the increase of N-ophile species and/or less attractive vegetation for grazing cows, even if the indicator seems to explain only a limited part of the variability of the phenomenon. The increase of ESI values seemed to lead to a loss of nutritive value of milk because of the incidence of health favourable fatty acids was reduced.

Key-words: dairy cow, alpine farm, sustainability, grazing, milk quality

INTRODUCTION

Mountain dairy farming is still a noticeable branch of agriculture in the North-East of Italy. However, during the last fifteen years more than 50% of dairy farms located in the mountain area of Veneto Region ended their activity. Meanwhile, the decrease of dairy cows was nearly 30% and number of cows per farm increased from about 12 to 22 (<http://statistica.regione.veneto.it>). Alpine grazing is limited to the summer and is characterized by high variability in growth and nutrient composition of pasture, both of which may limit dairy cows productive performance. Moreover, with the aim of increasing the profitability, farmers rear more and more high genetic cows, leading to increased levels of concentrate supplements used to match animals requirements. It is well known that offering supplementary feed in addition to hay-based diet to stalled or grazing dairy cows determines a reduction of fodder or herbage intake (Andrighetto *et al.*, 1996; Bovolenta *et al.*, 2002) and, as a consequence, it causes loss of agronomic and ecological value of the pasture (De Ros *et al.*, 2006); furthermore, increasing the amount of concentrate in the diet could modify the nutritional and organoleptic traits of dairy products, especially during the Alpine sojourn of dairy cows. Effects on milk fatty acids composition due to different levels and kind of concentrates have repeatedly been reported (Collomb *et al.*, 2002; Elia *et al.*, 2005), a feeding factor which also may contribute to low milk vitamins content (Elia *et al.*, 2006). The objective of the current study was to determine and validate an indicator as a tool to assess the impact of the different productive systems on the alpine pasture landscape, and to estimate the degree of correlation of this agronomic-zootechnical indicator with some nutritional quality traits of dairy products.

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MATERIAL AND METHODS

The study considered, in 2005 and 2006, 18 dairy farms located in the mountain area (above 1100 m a.s.l.) of Veneto Region called Plateau of *Asiago* and *Novegno*. Farms were selected in order to describe the main farming systems of the investigated area by productive performance of dairy cows and environmental conditions. In each farm a survey was carried out to describe the productive process and the ecological status of pasture by using ten agronomic and dairying variables (Andrighetto *et al.*, 1997; Cozzi *et al.*, 2006). The approach admired a definition of a score for each variables, that ranged from 1 (min potential negative impact on environment) to 10 (max potential negative impact on environment (Table 1) and a relative weight to summarize all the data in the calculation of an indicator, so-called Environmental Summarizing Indicator (ESI), whose total value ranged from 0 to 100. Botanical composition and nutrient content of pasture were assessed on July, 15 and Sept., 5. The pasture of 10 quadrates (1 m²), representing the range of pre- and post-grazing pasture masses of the farm, was visually assessed and then cut to ground level. Proximate composition of herbage was determined by AOAC (2000) and using an ANKOM methodology (ANKOM Tech., New York) to measure NDF content. In the same experimental period samples of bulked milk were analyzed for proximate composition with an infrared technique using a Milk-O-Scan 4000 infrared analyzer (Foss Electric, Hillerød, Denmark) and for fatty acid profile by gas-chromatography technique (Novelli *et al.*, 2004).

Table 1. Ranking of the main variables used to assess the Environmental Summarizing Indicator (ESI)

Score [#]	Breed/genetic merit	Milk production (kg/d)	Supplement per cow (kg DM/d)	<i>Poaceae</i> over other species	NDF of pasture (% DM)	Incidence of area with N-ophile species [§] (% pasture)
1	Burlina*	<10	<3.0	<45/55	<42	<10
2	Rendena/low	12	3.0	49/51	45	10
3	Rendena/medium	14	3.5	53/47	48	15
4	Brown/low	16	4.0	57/43	51	20
5	Holstein/low	18	4.5	61/39	54	25
6	Brown/ medium	20	5.0	65/35	57	30
7	Holstein/medium	22	5.5	69/31	60	35
8	Brown/high	24	6.0	73/27	63	40
9	Holstein/high	26	6.5	77/23	66	45
10	Holstein/very high	>28	>7.0	>81/19	>69	>50

[#]1: min ... 10, max potential negative impact on environment. *Burlina and Rendena are local Italian breed

RESULTS AND DISCUSSION

Among the variables considered, the daily milk production and concentrate supplement showed the highest correlation with ESI (Figure 1). As expected, botanical composition and nutritive content of pasture correlated lower with ESI than dairying variables. These results were probably due to the high variability of vegetation and ecological characters of pasture of each farm. In addition, investigated farms were often characterized by contiguousness and a relative homogeneity of herbaceous cover while the livestock density was quite lower compared to carrying capacity. However, milk production and/or level of the concentrate supplemented seem to affect floristic diversity. Low grazing activity determines the spreading of vegetable species less attractive for cows, as *Carex* spp and *Sesleria* spp; both of them tend to take a bushy shape that could limit the growth of other species (Da Ronch *et al.*, 2006). Moreover, the most productive dairy cows produce large amount of faeces that lead to increased nitrogen fertilization and spreading of nitrophilous species (i.e., *Rumex* spp and *Urtica dioica*).

It is well known that grazing alpine pasture affects fatty acids (FA) profile of milk, enhancing the amount of long-chain PUFA, of n-3 and of CLA (conjugated linoleic acid), and reducing medium and long chain SFA (Schroeder *et al.*, 2003; Lieber *et al.*, 2005). This effect is mainly due to pasture high content of PUFA and, in particular of linoleic and linolenic acid (Bailoni *et al.*, 2005). The % of CLA and C18:0 correlated positively with the percentage of pasture in the diet of dairy

cows. The increase of CLA as a function of herbage intake is probably mainly due to the concentration of vaccenic acid as a result of higher ruminal activity of cellulolytic micro-organism. The higher level of the stearic acid may be due to a higher activity of desaturase in the intestine and mammary gland of grazing cows (Collomb et al., 2002). In our study, only CLA seems to be negatively correlated with ESI (Figure 2) and this result may be due to a lower concentrate intake than differences in botanical composition of pasture.

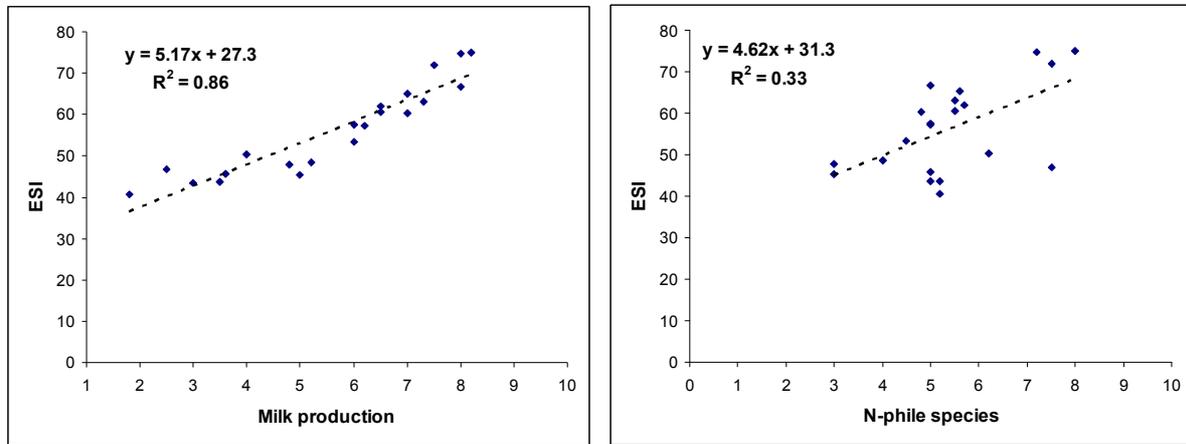


Figure 1. Correlation (♦) and linear regression (---) between milk production (1: <10 kg/d ... 10: >28 kg/d), on the left, or incidence of area with N-ophile species (1: <10% 10: >50% of pasture), on the right, and the Environmental Summarizing Indicator (ESI)

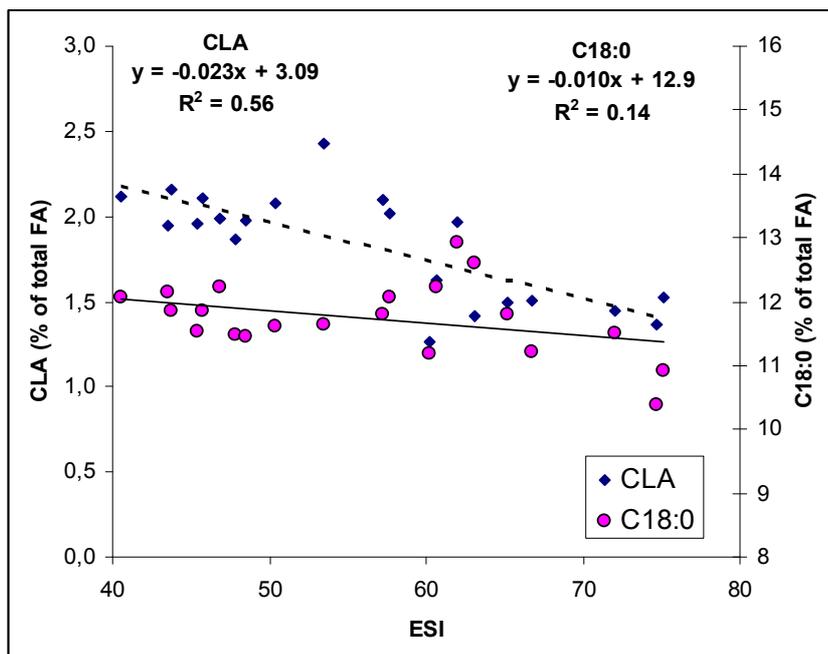


Figure 2. Correlation (♦; •) and linear regression (---; —) between CLA and stearic acid (% of total detected FA) and the Environmental Summarizing Indicator (ESI)

CONCLUSION

Results of the present study indicated that the assessment of an indicator of the adverse impact of dairy productive process on alpine habitat must be limited to a very short number of variables. There were strong relationships among productive factors that limited the variability of botanical and physical characteristics of pasture, especially in a geographic context where farming system was characterized by low stocking rates. The most important conclusion of this study is that the adverse effects of

farming system on mountain landscape seems to increase mainly as a function of milk production per cow. Quite apart the difficulties to define the Environmental Summarizing Index (ESI), it may be also considered as a tool to evaluate the nutritional value of milk. Therefore, although it is necessary to improve the quantitatively assessment, the concept of a potential indicator as a predictor of the likely response of the alpine grazing cows to supplementary concentrate on pasture and quality of dairy products should be developed.

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