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Source: Mountain Research and Development, 42(3)

Published By: International Mountain Society

URL: https://doi.org/10.1659/MRD-JOURNAL-D-21-00066.1

Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

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Consumer Liking and Value Perception of Mountain Cheese from Different Pasture Periods: Evidence for Mountain Systems Supporting Policies

Margherita Grandini[1], Marco Medici[1], Maurizio Canavari[1]*, Elisa Palmioli[2,3], Francesca Mercati[3], Andrea Catorci[4], and Paola Scocco[4]

** Corresponding author: maurizio.canavari@unibo.it*

[1] Department of Agricultural and Food Sciences, Alma Mater Studiorum - University of Bologna, Viale Fanin 44, 40127 Bologna, Italy
[2] PhD Course in "Ethics of Communication, Scientific Research and Technological Innovation" Medical-Health Curriculum, Department of FISSUF, University of Perugia, Piazza G. Ermini 1, 06123 Perugia, Italy
[3] Department of Veterinary Medicine, University of Perugia, Via San Costanzo 4, 06126 Perugia, Italy
[4] School of Biosciences and Veterinary Medicine, University of Camerino, Via Pontoni 5, 62032 Camerino, Italy

Every year, mountain pastures show a progressive impoverishment of forage. The loss in grassland feed value restricts the production period of local Pecorino cheeses, which strongly depend on the vegetative cycle of the pasture linked to climatic conditions. The Monte Fietone mountain area (Macerata, Italy) has emblematic pasture flora during spring and early summer. This unique environment is normally used for rearing sheep, allowing regular production of local Pecorino cheeses from their milk, which is rich in vitamins and intrinsic floral aromas. Biologists and agronomists are giving increasing importance to these mountain food products. We conducted sensorial tests and experimental auctions to investigate recognition of the quality of this rare artisanal product. The results indicate considerable potential for economic differentiation. Accordingly, we recommend useful and applicable marketing and policy actions to support the sustainability of mountain grazing systems.

Keywords: *local food; mountain food; sensory test; willingness to pay (WTP); Apennine cheese.*

Received: *2 November 2021* ***Accepted:*** *7 April 2022*

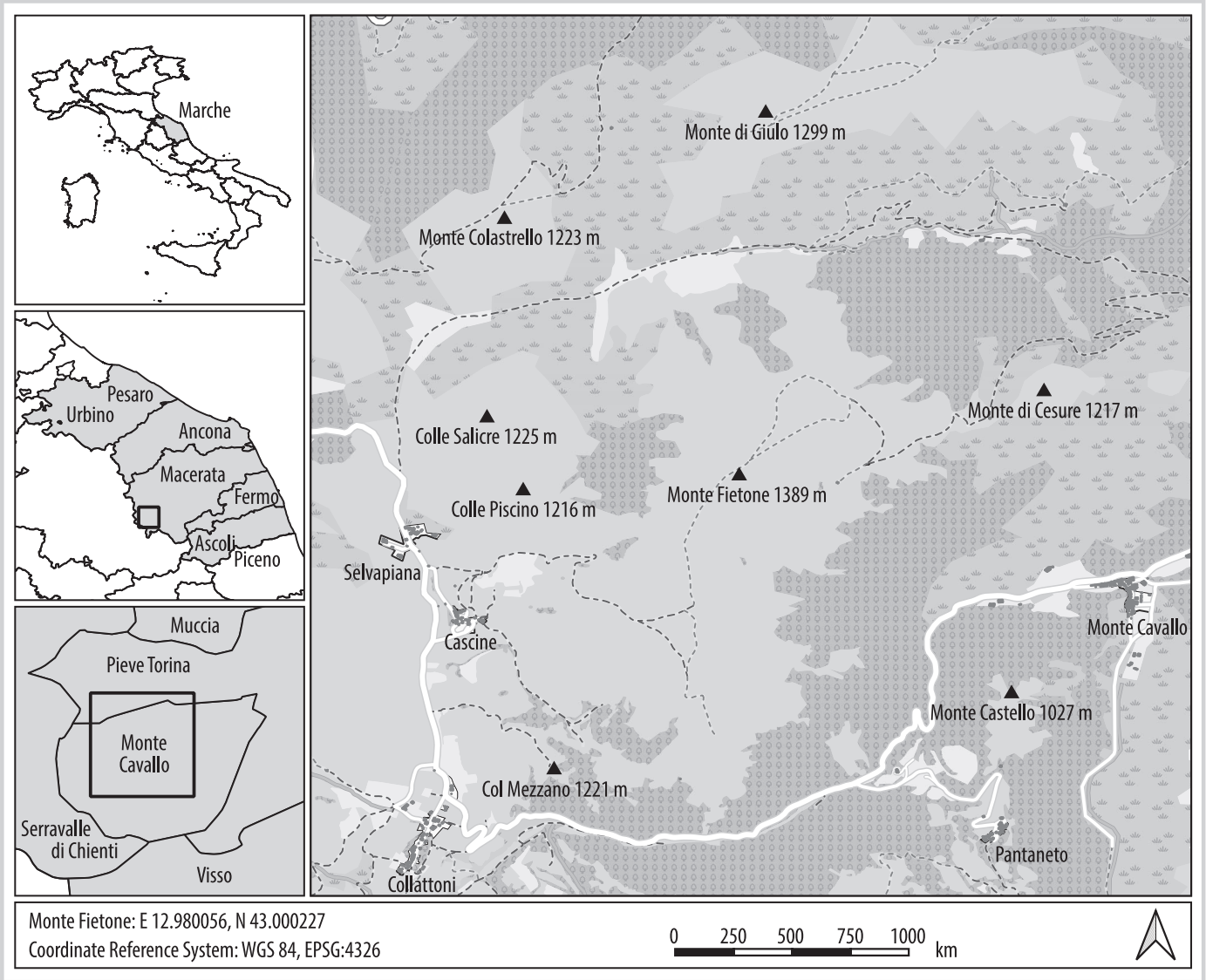
Introduction

In recent years, numerous studies have linked the diffusion of local food systems to the preferences of consumers searching for high-quality products (Marsden et al 2000; Renting et al 2003; Kriewald et al 2019; Jarzębowski et al 2020). It is well known that many local products cannot be reproduced in other areas of the world without losing qualitative, chemical, and sensorial characteristics and their extrinsic cultural value. In this context, mountain agricultural activities are gaining importance. For instance, many agrozootechnical farms in Italy's central Apennines take advantage of their pastures as a natural trophic resource for flocks. The livestock and farmers benefit from the flourishing forage composition, and the unpasteurized raw milk is used to produce local cheeses. In the Monte Fietone area, Macerata, Italy (Figure 1), sheep's milk largely retains the floral aromas of pasture-specific plant species and contains high levels of nutrients, such as vitamins A and E (Caprioli et al 2020). These organoleptic properties gathered from this specific environment can be found in the final milk-derived products, and they combine to define the uniqueness of local artisanal cheeses.

However, these final product features largely depend on specific climate and weather conditions. The increasing summer aridity registered in recent years, causing the flowering peak to occur earlier in the year, has decreased pastoral quantity and quality; in addition, it has shortened the period between maximum flowering and maximum dryness of pastures. Moreover, artisanal cheesemakers have recorded a sharp decline in milk production during the grazing period, probably because of this alteration of the plant vegetative cycle (Scocco et al 2018). The pasture of Monte Fietone spans 2 peaks: maximum flowering between June and July and maximum dryness between July and August. There are noticeable differences in the vitamin content and organoleptic features in terms of volatile compounds and fatty acids in the milk and the cheese produced immediately after these periods (Caprioli et al 2020). Biologists have shown that drought dynamics cause forage features to worsen, with negative effects on both animal welfare and sustainability of sheep farming (Scocco, Piermarteri, et al 2016). Changes in forage attributes reduce the sheep's body condition, with a deterioration in nourishment caused by an increase in rumen keratinization and a presumed reduction in the absorption of volatile fatty acids (Scocco, Mercati, et al 2016; Barbato et al 2021).

These conditions cause cascade effects on the final products; therefore, they are worthy of investigation from a critical perspective on potential consumer demand

FIGURE 1 Monte Fietone. (Map by Danilo Procaccini)



adjustments resulting from a changing climate. In addition, the economic growth of mountain activities is strongly linked to solid relationships between producers and consumers (Cantiani et al 2016; Montrasio et al 2020). The value of mountain farming is strictly related to the concept of short food supply chains, because they are commonly associated with a range of recurring characteristics and values and are perceived as reestablishing authenticity in production and consumption (Lamine 2005; Wittman et al 2012; Bernués Jal et al 2013; Vittersø et al 2019; Medici et al 2021).

A change in forage attributes directly affects livestock rearing, and maintaining animal welfare is necessary for the sustainability of sheep farming in mountainous areas (Broom and Fraser 2007; Barbato et al 2021). The process of drought stress intensification can trigger further problems. For instance, it can reduce the carrying capacity of rangelands and the buffering ability of pastoral systems, entailing the need to adapt grassland management to the loss of grassland feed value (Nardone et al 2010). Such action will likely be cost dependent, so every action that improves the economic value of breeding activities by ensuring a higher economic income for the farmer will be crucial to maintaining grassland biodiversity and livestock welfare. The decline of product quality within the same season is poorly investigated. It affects limited but significant low mountain areas like the Apennines. However, many European study settings only consider the European Alps, where grasslands are particularly rich in species (Klötzli et al 2010; Spehn et al 2010), despite facing other issues, such as abandonment and intensification (Spehn et al 2010; Herzog and Seidl 2018). Similar issues affect the Pyrenees, which have also experienced the progressive replacement of traditional sheep rearing with beef cattle (Garcia-Ruiz and Lasanta-Martinez 1993; Muñoz-Ulecia et al 2021).

This research addresses a different and more recent concern. A key consideration is whether consumers perceive a different value for products derived from milk produced in different pasture periods that reflect quality loss. Accordingly, we examined consumers' preferences and value perception toward mountain products, particularly cheese produced in the area of Monte Fietone.

FIGURE 2 The 3 Pecorino cheese samples: (A) 592, (B) 746, and (C) 077. (Photos by Paola Scocco)

Material and methods

Field experiments were conducted at the Informatics Laboratory of the University of Camerino in April 2017. A sample of 92 participants was recruited using a nonprobabilistic convenience sampling method to obtain a self-selected sample of artisan Pecorino cheese consumers. Participants' age ranged between 20 and 80 years, averaging 40.2 years; 53% of the respondents were female, and 47% were male. Respondents were selected according to cost-effectiveness and speed, so the sample did not represent a full range of consumers and was mainly composed of professors, employees, and students at the universities of Camerino, Perugia, and Bologna, Italy. Nevertheless, nonprobabilistic sampling methods can yield appreciable insights into the phenomenon studied and can even accurately measure a phenomenon if the sample bias is not linked to differentiated behavior, even though this sampling approach does not allow the reliability of the measures to be estimated. Experiments were split into 2 consecutive steps. Each participant tested 1 sample each of 3 types of local Pecorino cheese in the first step, expressing preference scores for each cheese and verifying possible sensorial differences among them. The second step consisted of economic investigations based on the best and most valuable cheese, using a willingness to pay (WTP) elicitation setting. Specifically, each participant's WTP was measured through experimental auctions, with a real market environment simulated with real monetary transactions (Lusk and Shogren 2007; Canavari et al 2019). A fifth-price mechanism was applied in the auctions: participants were asked how much they were willing to pay for a sample of local Pecorino cheese, and the auction was won by the highest 4 bidders, whose real expenditure would be equal to the fifth-highest offer. Participants were asked to follow the survey and place bids on their smartphone or tablet or to use a computer in the laboratory. The questionnaire and the related data were collected using Qualtrics software (Qualtrics 2020).

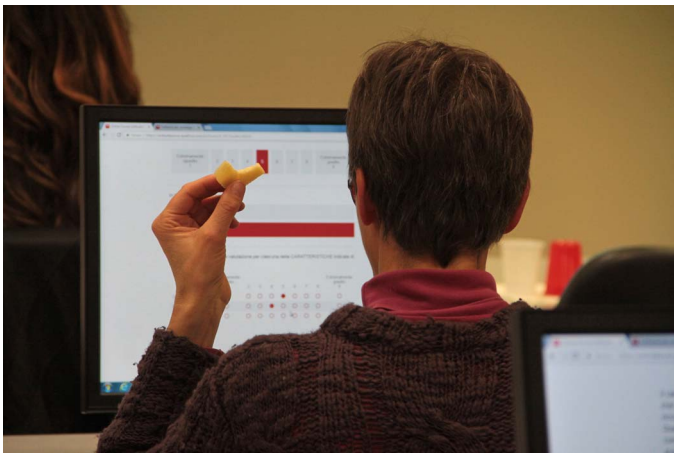
Cheese sample description

Three samples of Pecorino cheese were selected for the sensory experiments. The first cheese, sample 592 (Figure 2A), was derived from milk produced by a flock fed with fresh forage only until 7 July 2016, which was recognized as the period of maximum flowering of grass species on Monte Fietone. Because of these conditions, this cheese preserved the flavor of floral aromas of typical local grass species. This sample, available in large enough amounts, was also selected for further economic evaluations. The other cheese samples formed 2 subgroups, an experimental group (sample 746, Figure 2B) and a control group (sample 077, Figure 2C). Both cheeses were derived from milk produced by a flock fed with forage after 7 July 2016. Specifically, cheese sample 746 was from a flock that also received daily food supplementation of 600 g/head of cereals (barley and maize in equal proportion). This sample contained high amounts of vitamins A and E, fatty acids, and volatile compounds similar to those of sample 592 (Caprioli et al 2020). The third cheese, sample 077, was derived from a flock that had only eaten forage on pastures until 9 August 2016, when the maximum pasture dryness became evident through yellowing leaves. Based on a drier forage, this type of cheese was characterized by lower vitamins, fatty acids, and olfactory descriptors compared with the other 2 samples.

Sensory test

The 3 cheeses, samples 592, 746, and 077, were presented to participants on separate, numbered paper dishes. To limit biases, no information concerning cheese characteristics was given before the tasting experiment: participants were unable to identify the particular type of cheese apart from the taste. Participants tasted the 3 samples in a randomized order, and each tasting was punctuated by an interval of 15–20 minutes, during which participants answered a block of questions under blind conditions (Figure 3). For each sample, they indicated their personal liking on a 9-point

FIGURE 3 Consumer sensory test. (Photo by Marco Montecchiari)



linear scale over 4 categories: smell liking, flavor liking, texture liking, and overall liking.

Experimental auctions

The economic experiments performed in this study were based on experimental auctions, from which participants' WTP for real products can be determined (Lusk and Shogren 2007). More specifically, we adopted a fifth-price experimental auction procedure to elicit preferences toward cheese 592. Before entering the core of the experiments, 4 sessions with 15–20 individuals each were run to inform participants about the auction mechanism and the auctioned cheese. A trial auction was conducted in which a 240-g mayonnaise jar was used as the test product. Following this, each participant was given a 200-g piece of common Pecorino cheese, available from local retailers at an average price of € 12.50/kg (US$ 13.31/kg). The auction mechanism required participants to place their bids individually in a sealed envelope at the same time. After that, the 4 highest bids were identified for each session to select the 4 successful bidders who purchased auctioned cheese 592 (Figure 2A) at a price defined by the fifth-highest bid, giving back the cheese they had been given and paying the difference. Bids were expressed in euros per kilogram because the 4 auctioned pieces of cheese and the cheese given to participants were slightly different in weight.

Results

Sensory tests

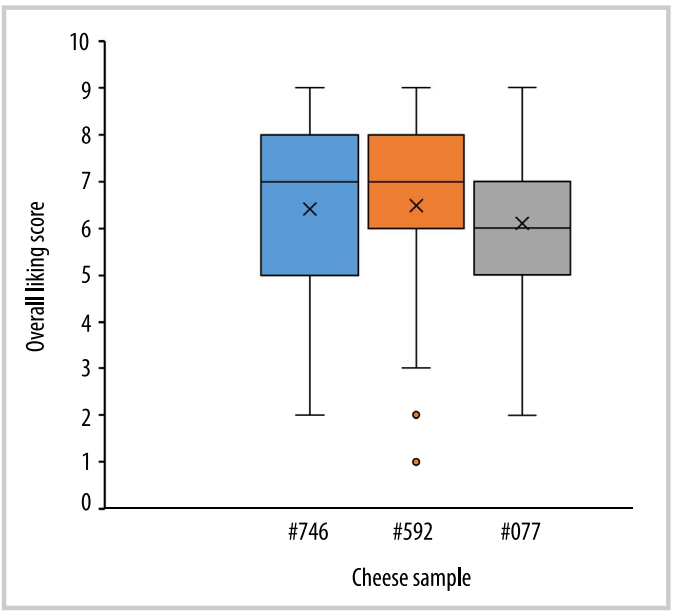
There were 45 male and 47 female respondents, with an average age of 40.2 years. All liking scores were analyzed to determine consumers' preferences for cheese samples 592 and 746 over sample 077, which was, as expected, the least preferred cheese, even though sample 592 showed slightly lower performance in terms of smell and texture liking (Table 1). Overall liking of samples 592 and 746 was higher than that of control sample 077. The distribution of overall liking for each sample is reported in Figure 4. The data revealed a slightly higher overall score for cheese sample 746, but despite lower scores for the individual sensory categories, the higher-quality sample 592 scored almost as high. Control sample 077 scored lowest for overall liking. To verify whether survey data were a close enough approximation to make the estimates reasonable, we first checked the normal distribution of observations of each sample across the 4 categories of smell liking, flavor liking, texture liking, and overall liking. We then performed an *F*-test. The Shapiro–Wilk normality test was greater than 0.90 for all samples across the categories; also, no significant difference was found in the variances of the overall liking scores, with the *P* value of the *F*-test greater than the 5% significance level.

TABLE 1 Overall results of the sensory tests.

Sample	Smell liking		Flavor liking		Texture liking		Overall liking	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
592	5.8	1.9	5.9	1.9	6.2	2.0	6.4	1.6
746	6.1	1.8	6.4	1.9	6.5	1.8	6.5	1.8
077	5.9	1.8	5.9	1.8	6.3	1.7	6.1	1.8

Note: SD, standard deviation.

FIGURE 4 Boxplots of liking scores. Crosses denote averages, circles denote outliers, and horizontal lines denote quartiles.



Economic assessment

In total, 92 bids for sample 592 were collected from the auction sessions. The maximum bid amounted to € 30/kg (US$ 31.95/kg) and the minimum amounted to € 7.25/kg (US$ 7.72/kg), with an average of € 18.63/kg (US$ 19.84/kg) and a standard deviation of 3.62. Most bids were higher than the reference price of the common Pecorino cheese (€ 12.50/kg or US$ 13.31/kg) given to participants. The bids were thus grouped into cumulative frequency classes to describe the empirical demand curve for sample 592. This was interpolated to check the linear relationship between price and quantity, in the form of cumulative share (Figure 5). Such a relationship can be particularly significant for cheese producers because it enables them to see how product demand responds to price changes. The potential revenue resulting from the various price levels measured is shown in

FIGURE 5 Demand curve with linear interpolation of price against buyers' share. Conversion rate at time of study: € 1 = US$ 1.065.

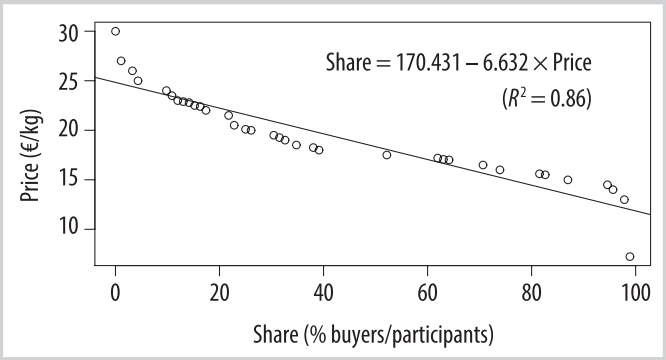


FIGURE 6 Revenue trend as a function of the product price; the dashed line denotes the actual price, and the dotted line denotes the revenue maximizing price. Conversion rate at time of study: € 1 = US$ 1.065.

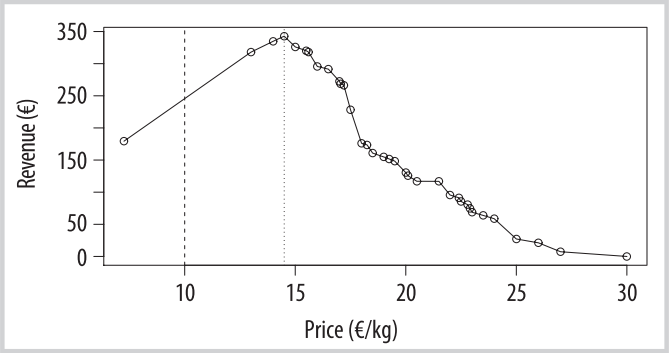


Figure 6. According to participants' preferences, the optimal price for maximizing revenues is € 14.50/kg (US$ 15.44/kg), considerably higher (+45%) than the actual price of € 10.00/kg (US$ 10.65/kg) charged by local producers for artisan Pecorino cheese.

Discussion

This study investigated consumer perception of milk-derived products produced during different pasture periods associated with differing quality. A total of 92 participants showed an overall preference for products derived from milk produced in the best pasture periods. One of these products was chosen to be auctioned in experimental auctions, in which the same participants revealed a higher appreciation of it than of a comparable retail product.

The study results suggest some important considerations for local cheese producers. As expected, the sensory analysis revealed higher preferences for cheese samples with additional attributes compared with control sample 077. It also confirmed that the interaction of texture and taste affects consumer acceptance of food, and this was demonstrated by the preference for both samples 592 and 746. Results from the economic assessment were encouraging, considering the variability of the market, the experimental settings, and the limited number of participants. In general, more than half of the participants were willing to pay more for the best samples, corresponding to their nutraceutical and antioxidant value because of the high content of vitamins A and E. We recommend that local producers promote these characteristics of their products by highlighting their richness in fatty acids, volatile compounds, vitamins, and floral aromas to generate positive feedback from consumers.

The experimental auction sessions highlighted an optimal trade-off between consumers' WTP and the price charged. Local producers used to charge € 10.00/kg (US$ 10.65) for each type of cheese, whether it was produced at the end of the summer, obtaining in this case a cheese similar to control sample 077, or at the beginning of the summer, obtaining a cheese of higher value, similar to sample 592. Because, in a mountain setting, more than half of the production is concentrated in the first half of summer, local producers do not maximize their revenue, which could be achieved with a slight price adjustment. Thus, there is room to better advertise higher-quality cheese and charge higher prices, and both strategies can maximize the revenue needed by small farmers to compete with larger producers.

The observed results are in accordance with other studies investigating consumer perception of mountain cheese products. Endrizzi et al (2021) reported liking scores ranging from 6.0 to 7.3 for mountain cheese produced in a similar context. Marescotti et al (2021) provided evidence about an overall, albeit small, premium price given to high-quality summer cheese and the effectiveness of promotional messages based on sensorial characteristics and the anticipated taste of cheese. Further studies could try to identify a precise value for texture and flavor for which consumers are willing to pay a price premium.

Consumers have high expectations of mountain products. In general, consumers expect mountain farming to be healthier than nonmountain farming systems (Zuliani et al 2018), and the choice of mountain products is positively correlated with the green attitudes of consumers (Mazzocchi and Sali 2019; Mazzocchi et al 2021). Therefore, mountain products could be better promoted with targeted communication strategies, such as labeling schemes highlighting their quality and sustainability attributes (Linder et al 2021).

However, mountain products, particularly those from the Apennines, are at risk. This results from the increasing summer aridity registered in recent years, which has resulted in a decrease in pastoral quantity and quality and a shortening of the period between maximum flowering and maximum dryness of pastures. This impoverishment threatens grassland biodiversity and livestock welfare, which are strictly related: the grazing activity is fundamental to maintaining the pasture biodiversity, favoring the presence of many orchid species. Reduced grazing activity negatively affects biodiversity and, in turn, can have a negative effect on tourism and the local economy (Parente and Bovolenta 2012). However, without adequate livestock welfare, flock productivity is not enough to guarantee sufficient farm income (Catorci et al 2011; Carmona et al 2012; Scocco, Piermarteri, et al 2016; Mercati et al 2018).

Conclusions

This study highlighted consumer sensory and economic preference for products derived from milk produced from pasture with flourishing forage composition, demonstrating

that high-quality mountain dairy products have good margins of appreciation.

In addition to the underdeveloped economic structure, the mountain context considered in this study suffers from exogenous environmental problems, such as increasing summer aridity over the years, which, in turn, causes the forage to deteriorate. Not surprisingly, the main sensorial attributes that can be found in the final products are threatened, and high-quality products from grazing systems, which are a key factor for the conservation of mountain communities, are at risk. Therefore, support schemes encouraging farmers to maintain sustainable and high-quality production are needed. The mountain product certification promoted at the European level (Regulation 1151/2012 and Delegated Act 665/2014) guarantees environmental sustainability of extensive production processes in a mountain context but must be complemented by additional supporting policies. Local producers should be incentivized to abandon short-term views concerning their pastoral activity in favor of a more systemic and holistic view of the natural heritage locally available. This should be based not just on the high nutraceutical and antioxidant value of local produce but also on other mountain features, such as the beauty of the mountain environment during the flowering period. These features can also lead to better mountain and agritourism value enhancement, strengthening consumers' perceptions of food produced in mountain areas that represent a value per se, a symbol of natural, healthy, and environmentally friendly production. The close producer–consumer relationship plays an important role in fostering the maintenance and sustainability of pastoral systems. Adequately targeted communication strategies to promote high-value products and attract new consumers, based on consumers' knowledge of mountain production systems, are of pivotal importance for local producers that mostly undersell their produce.

The small sample size and its bias constitute the study's main limitation. However, the topic examined is new and original, and this research can prepare the way for future investigations concerning other mountain products at risk. Further studies could also try to assess an economic value for cheese texture and flavor for which consumers are willing to pay.

ACKNOWLEDGMENTS

We acknowledge the financial support of the research project CLIMAPP (CLImate changes, grasslands and livestock Management: a multidisciplinary study to improve the sustainable development of APennine Pastoral systems) (Fondo di Ricerca di Ateneo [FAR] 2014-15) funded by the University of Camerino. The fund owner is A. Catorci. He shares senior coauthorship of this paper with P. Scocco. The authors are grateful to Caseificio Di Pierantonio (Belforte del Chienti, Macerata, Italy) for sheep management and providing cheese samples. The authors are also grateful to Lucia Bailetti and Matteo Bonfini (Cias Innovation S.R.L., Macerata, Italy) for their support in organizing the consumer tests.

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