Colour traits in the evaluation of the ripening period of Asiago cheese

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ABSTRACT – The research was carried out on Asiago d'Allevo cheese samples produced in a single farm located in the Altopiano dei Sette Comuni (above 1000m a.s.l.). After 6-12-18 and 36 months of ripening, samples were analyzed for quality traits, in order to evaluate the effect of ripening on colour and gross composition. As expected crude protein and fat significantly increased through the considered period. Ripening led to a significant decrease of L*, a* and b* values. Lightness showed a negative relationship with crude protein, meanwhile a* and b* were both negatively related to fat content. Concerning L*, the trend could be explained by water loss and N-soluble compounds concentration, which could alter protein matrix. a* and b* reduction was probably related to degradation processes such as lipolysis, which seemed to be extensive in hard and long ripened cheese. Ripening affected significantly the light reflectance at all λ with green cheese having the higher values.

Key words: Colour, Ripening period, Asiago d'Allevo cheese.

Introduction – Cheese colour is influenced by many factors such as the milk pigments content, like β-carotene with regard to the feed and to the botanical composition of pasture in grazing cattle. Changes in cheese colour could be also related to the biochemical activity of the native microflora, the technological processes and the ripening technique (McSweeney, 2004; Dufossé *et al*., 2005). Although concerning cheese colour there are many studies, there is a lack of data on the effect of ripening on light reflectance at different wavelengths and its possible usefulness. The present study is a preliminary attempt aimed at evaluating the effect of ripening on colour and gross composition of PDO Asiago d'Allevo cheese.

Material and methods – Milk was obtained from one dairy cows herd from an alpine farm located in the so-called Altopiano dei Sette Comuni (above 1000m a.s.l.; Vicenza, Italy), during three experimental periods: May, 25/barn/total mixed ration; July, 15/alpine grazing/pasture and concentrate (a daily dose of 4.5 kgDM) and September, 5/alpine grazing/pasture and concentrate (4.0 kg DM). Cheese (n=21) was manufactured after joining skimmed overnight and whole morning raw milk. After microbial culture inoculation, calf rennet was added at 37°C. The gel mass was then finely cut and temperature still raised to 45-48°C. The curd was finally extracted and placed in the moulds for forming. The pre-salting step took 12 to 48h at 13-15°C and 85% of RH. and salting by means of immersion in liquid brine (20±2°Bé). Cheeses were ripened for 6, 12, 18 and 36 months (mo) in a storage bay (10±2°C and 80±5% of RH.). Water activity (a_w) was measured by Aqualab CX-2 tool (Decagon, USA); pH was determined after sample homogenization in distilled water (1/10w/v). Cheese samples were homogenised and analyzed for gross composition (AOAC, 2000). Colour was assessed after exposure to air (1h, 2±2°C) on 5 consecutive points from the rind to the centre by a spectrocolorimeter (C508, Minolta Camera Co., Osaka, Japan) set on illuminant D65 and with

a 10° observer. Data were expressed according to CIE L*a*b* colorimetric system. Moreover the percentage of reflected light over the wavelength (λ) range from 400 to 700 nm (in 10- nm increments) was measured. Statistical analysis considered ripening (R; 4 levels) and cheese production system (S; 3 levels) as main effects, their interaction (RxS) and cheese weight as covariate. ANOVA was supported by the GLM PROC of SAS (2002). When ripening was significant (P<0.05), LSM were separated using the PDIFF option along with SCHEFFE adjust.

Results and conclusions – The cheese production system (S) had a significant effect on colour traits, since alpine grazing-cheese showed significantly (P<0.05) lower values of L* and higher values of b* (data not tabulated for brevity).

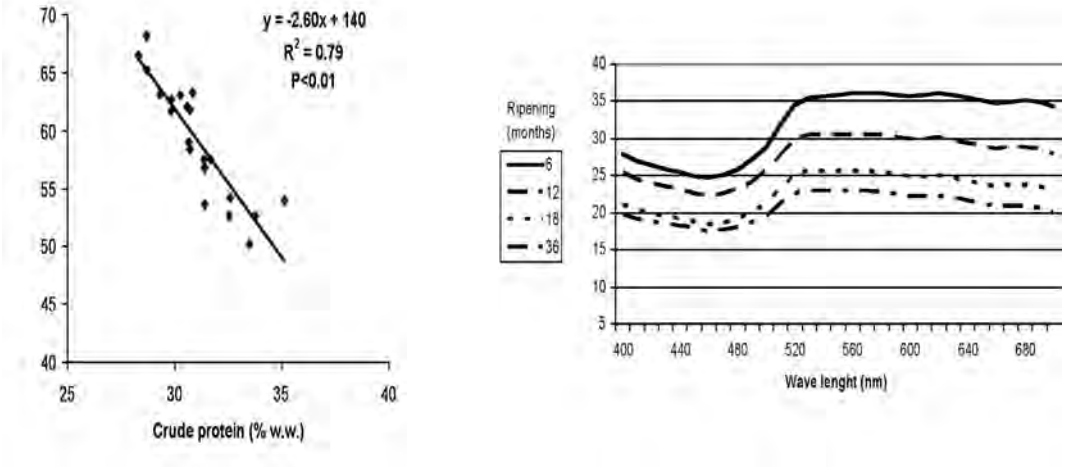
The interaction between ripening time and cheese production system (RxS) was not significant as regards to colour parameters and chemical traits, with the exception of pH, crude protein and fat percentage. The covariate cheese weight didn't affect significantly any results (Table 1). pH significantly changed as the cheese aged, showing the highest value at 18 mo and the lowest value at 12 and 36 mo. This pattern was probably due to the action of microflora and its influence on lactate concentration, as well as the formation of non acidic decomposition products and liberation of alkaline compounds due to proteolysis (McSweeney, 2004). Concerning gross composition (Table 1), the length of ripening significantly led to an increase of dry matter through the considered period; this result could be due to water surface evaporation as confirmed by the contemporary decrease of a_w. Crude protein and fat both raised until 36 mo. of age, but the fat increment tended to be significant only in the first year; this could be due to an active process of lipolysis which could have been stronger after 12 mo. Ash content didn't change significantly during the time considered. Ripening significantly influenced colour, resulting in a linear decrease of L* through the time of aging. In the case of b* it was observed a major decrease during the first year and after 18 mo. Redness (a*) resulted in a significant reduction but only in the first year. According to the literature (Dufossé *et al.*, 2005; Pinho *et al.*, 2005), cheese ripening led to a decrease of L*, but to an increase of b*; the difference with our results was probably due to the ripening time (36 *vs.* 3-4 mo) and to the degree of lipolysis that

Table 1. Effect of ripening (months) and cheese weight covariate (b) on pH, water activity (a_w), gross composition (% wet weight) and colour traits.

		Ripening time (months)					Cheese weight		SEM
		6	12	18	36	P	b	P	
n samples		5	7	5	4				
pH		5.77^{ab}	5.72^{b}	5.82^{a}	5.71^{b}	*	-0.01	ns	0.02
a_w		0.92^{a}	0.90^{b}	0.89^{b}	0.85^{c}	***	0.01	ns	0.01
Gross composition									
Dry matter	%	67.7^{d}	71.2^{c}	73.1^{b}	75.7^{a}	***	-0.75	ns	0.3
Crude protein	% w.w.	28.9^{c}	30.7^{b}	31.4^{b}	33.4^{a}	***	-0.06	ns	0.2
Fat	% w.w.	29.9^{b}	32.1^{a}	32.2^{a}	33.1^{a}	***	-0.54	ns	0.2
Ashes	% w.w.	5.4	5.1	5.3	5.8	ns	-0.11	ns	0.2
Colour traits									
Lightness	L*	65.4^{a}	60.8^{ab}	56.6^{bc}	54.1^{c}	**	-0.51	ns	1.1
Redness	a*	-1.10^{a}	-1.68^{b}	-1.95^{b}	-1.81^{b}	**	-0.07	ns	0.09
Yellowness	b*	12.2^{a}	9.4^{b}	9.5^{ab}	7.5^{b}	**	0.26	ns	0.5
Croma	C	12.3^{a}	9.6^{b}	9.7^{ab}	7.8^{b}	**	0.25	ns	0.5
Hue	H	96.0^{c}	101.1^{b}	102.2^{ab}	104.8^{a}	**	-0.44	ns	0.7

*$^{a, b, c, d}$ and *=P<0.05; $^{A, B}$ and **=P<0.01. b=regression coefficient of whole cheese weight (kg) covariate. pH, crude protein and crude fat showed a significant interaction between ripening time and cheese production system.*

Figure 1 (on the left). Correlation between crude protein and lightness. (on the right). Effect of ripening time (P<0.01 at all λ) on light reflection (%) at different wavelength (nm).



seemed much higher, like in other hard cheeses. L* showed a negative correlation with the protein percentage (Figure 1), meanwhile there wasn't a correlation with the fat content.

It's well known that in raw milk cheese there is a high rate of increase in water-soluble nitrogen (SN) through ripening time. Both the lower moisture and the higher SN content could cause an increase of mechanical openings in the surface and the formation of a less homogeneous and compact protein matrix resulting in a reduction of lightness values (Pavia *et al.*, 1999). Concerning the yellowness and the redness, both showed a negative correlation with fat (R^2=0.77 and 0.72 respectively; P<0.01), although this relationship could be due to other phenomena such as lipolysis and/or changes in microflora (Dufossé *et al.*, 2005). Ripening affected significantly also the percentage of reflected light at all λ (Figure 2); green cheeses reflected more light than the older one. According to Carpino *et al.* (2006), reflectance values were lower at wavelengths inferior to 500 nm and higher over 520 nm. In conclusion, ripening affected significantly colour traits of *Asiago d'Allevo* cheese, and some of them seemed related to cheese gross composition. In the future would be interesting to evaluate if λ could be more useful to discriminate between different origin (production system) and ageing time.

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