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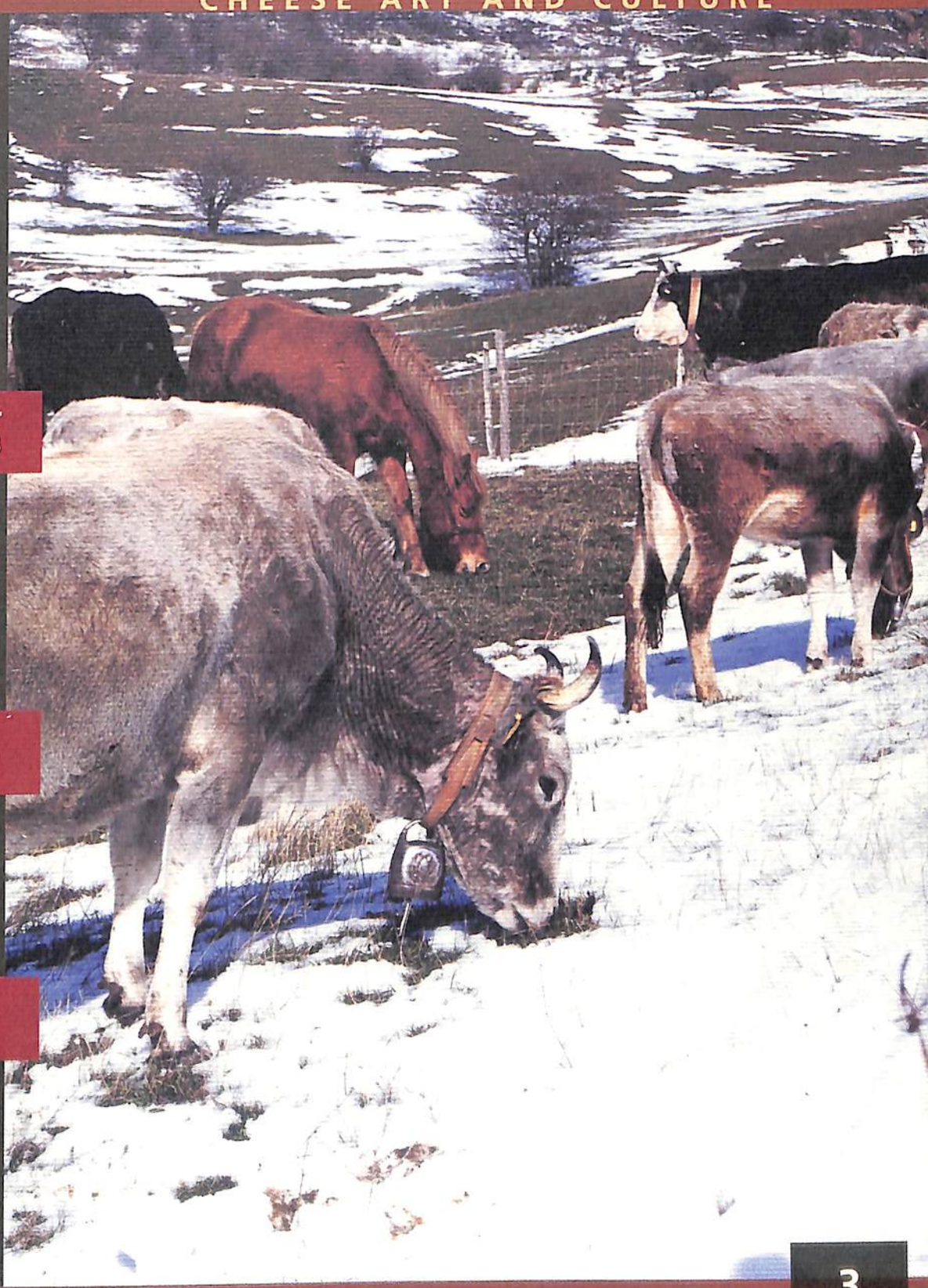

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Highland Cheeses

CLA composition of Piedmont "Ossolano" cheese

CLA composition od Piedmont "Ossolano" cheese

By G. Zeppa, G. Calabrese, V. Gerbi, M. Giordano

Lipids are very important components of human food, which carry out indispensable life functions. Modern guidelines for a healthy diet recommend however to reduce animal fat consumption especially if rich in saturated fatty acids in relationship to their by now well-demonstrated hypercholesterolemic effect. But it is important to remember that there are also unsaturated fatty acids, which may not only reduce the cholesterol content in the blood, but also in some cases even have anti-tumor effects.

Very important among these compounds are the conjugated linoleic acids (CLA) and their increased content in milk may have favourable impact in the areas of cancer research, human nutrition, and the public perception of dairy products. CLA are the only fatty acids shown unequivocally to inhibit carcinogenesis in experimental animals. Others benefit include action of CLA as an antioxidant, immune system modulator, anti-arteriosclerosis agent, body weight protector and body fat reducer.

Diet could modify the chemical composition of milk and thus influence the composition of milk products. Recent studies have shown that pasturing or feeding cows with green forage determines an increase of the unsaturated long chain fatty acids and a reduction of the short chain saturated ones. This effect is particularly evident in the artisan mountain cheeses due to prolonged grazing on a variety of vegetal essences even though there are not yet many studies on these particular products.

Modern guidelines for a healthy diet recommend to reduce animal fat consumption. However, the CLA, having such an anticarcerogenic effect, are contained just into the fat. For example, in the highland cheeses

The aim of this work was to verify if for the 'Ossolano' cheese, one of the best-known Piedmont cheeses it was also possible to observe a fatty acids difference between the summer production (cows fed with green forage in mountain pasture) and the winter production (cows fed with hay and concentrate in valley farms).

SAMPLES

The 'Ossolano' cheese is a round semi-hard cheese weighing 8-9 kg and made using raw milk exclusively from Bruna Alpina cows. This cheese is produced in the north of Piedmont, in the alpine zone bordering Switzerland. For the cheesemaking raw whole (in summer) or raw partially skimmed (in winter) cow milk is coagulated without starter at 34-37°C by adding bovine rennet. The curd is cut with a wire cutter into 3-4 mm curd particles. The curd-whey mixture is heated to 45-48 °C over a period of 40-45 min and then stirred without heating for a further 40 min. The curd is finally removed and placed in

moulds, drained and pressed for 24 h. The cheeses are then removed from the moulds, salted dry for 48 h after which they are ripened for at least 60 d at 8-12 °C in curing rooms at high humidity (80-90%).

The survey was carried out on 66 cheese samples of which 24 were from the summer production of mountain farms located between 1,500 m and 2,200 m (7 producers) and 42 from the winter production of valley farms (6 producers). Summer feeding was exclusively green forage in mountain pastures whereas hay and concentrate were used for winter feeding.

RESULTS AND DISCUSSION

In Table the composition in FAMEs with 4 to 20 carbon atoms of summer and winter cheeses was reported.

Transition from hay/concentrate diet to grazing diet was followed by a great increase in the proportion of saturated, mono- and poly-unsaturated long chain fatty acids ($C_{18:0}$, $C_{18:1}$, $C_{18:2}$, $C_{18:3}$).

Very important for its nutritional effect is the increment in the summer cheeses of conjugated linoleic acids, also know as CLA. In Table the percentage of the most important isomer, the cis-9, trans-11/trans-9, cis-11-linoleic acid or rhumenic acid and the sum of the other five geometric and positioned isomers were reported separately for these compounds.

Rhumenic acid was reported separately because is considered to be the most important CLA in terms of anticarcinogenic activity. In fact it is the only isomer incorporated into phospholipidic fraction of tissues, modulates the activity of cytochrome P450, reduces the induction of ornithine decarboxylase and protein kinase C known as tumour production indicators, and probably inhibits protein and nucleotide biosynthesis.

The high content of c-9, t-11-$C_{18:2}$ found in the summer cheeses can be due not only to pasturing as reported by other authors but also to the milk-contaminating microflora activity and the cooking of the curd (45-48 min at 40-45 °C) used in 'Ossolano' production.

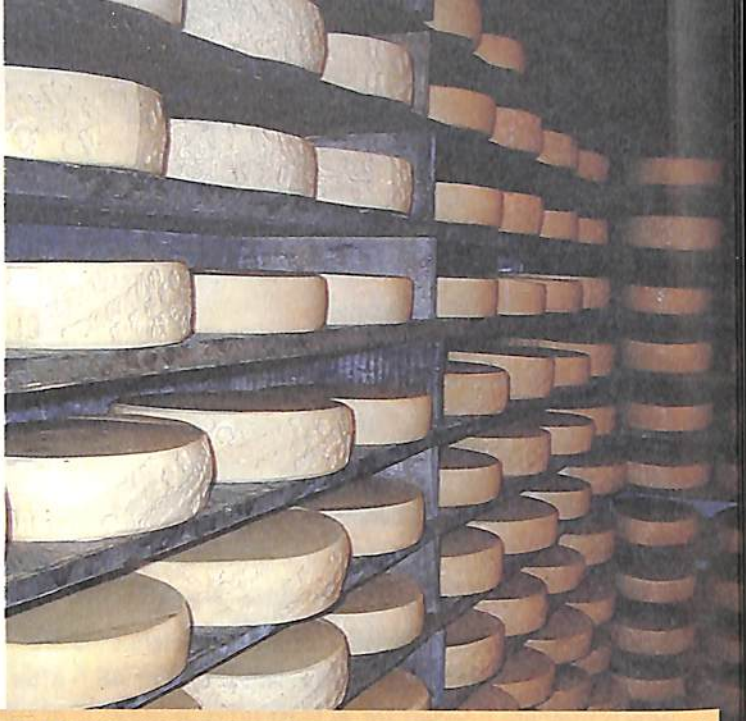
The agitation of cheese curd during cooking facilitates CLA formation by incorporating air, enhancing the initiation of lipid oxidation and the production of linoleic radicals. Moreover the interaction between proteins and fat globules increases and enables proteins to donate hydrogen to convert linoleic acid radicals to CLA.

CLA are the intermediate stage of full biohydrogenation of linoleic acid to stearic acid, then in the summer cheeses there is also an increment of $C_{18:1}$ and $C_{18:0}$.

CONCLUSION

This preliminary work has confirmed also for "Ossolano" cheeses that a different feeding can significantly influence the cheese fat composition. Then saturated, mono- and poly-unsaturated long chain fatty acids were more abundant in summer cheeses produced with milk of cows fed in mountain pastures. These differences of good quality and 'typicality' factors along with others parameters such as terpenes, sesquiterpenes and aromatic polyciclic hydrocarbons could be used to indicate the mountain origin of

Highland Cheeses



the cheese in the prospect of an application "Protected Denomination of Origin " (PDO).

ACKNOWLEDGEMENT

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Table - FAMEs composition (C4 to C20) of summer (24 samples) and winter (42 samples) cheeses

	Winter cheeses		Summer cheeses	
	x	σ	x	σ
$C_{4:0}$	3.51	0.37	3.11	0.22
$C_{6:0}$	2.34	0.21	1.73	0.19
$C_{8:0}$	1.47	0.18	0.99	0.19
$C_{10:0}$	3.01	0.47	1.92	0.44
$C_{10:1}$	0.37	0.10	0.23	0.05
$C_{12:0}$	3.25	0.85	2.07	0.39
$C_{13:0}$	0.11	0.04	0.12	0.05
$C_{14:0}$	11.92	0.85	8.32	0.82
$C_{14:0\ branched}$	0.20	0.07	0.22	0.04
$C_{14:1}$	1.04	0.14	0.67	0.11
$C_{15:0}$	1.24	0.14	1.48	0.23
$C_{15:0\ branched}$	1.03	0.15	1.19	0.11
$C_{16:0}$	30.74	1.89	24.26	1.00
$C_{16:0\ branched}$	0.41	0.08	0.38	0.08
$C_{16:1}$	1.48	0.14	1.65	0.19
$C_{17:0}$	0.74	0.20	0.93	0.13
$\Sigma(C_{17:0\ branched})$	1.22	0.15	1.30	0.26
$C_{17:1}$	0.34	0.09	0.41	0.12
$C_{18:0}$	10.17	0.95	12.72	1.06
$C_{18:1}$	21.48	1.74	29.37	1.75
cis-9, *trans*-11-$C_{18:2}$	0.89	0.16	2.23	0.42
$\Sigma(C_{18:2})$*	2.48	0.55	2.95	0.48
$C_{18:3}$	0.75	0.15	1.30	0.25
$C_{20:0}$	0.15	0.06	0.28	0.10
$C_{20:1}$	0.14	0.06	0.19	0.06
Σ saturated fatty acids	71.51	3.33	61.00	1.75
Σ unsaturated fatty acids	28.08	1.92	36.77	1.66

The results are shown for each FAME as a percentage of total FAMEs
x - mean value
σ - standard deviation
* - Sum of all conjugated geometric and positional isomers of linoleic acid except for cis-9,trans-11-$C_{18:2}$ isomer