Effect of lactose and of drying temperature on the quality of Italian salami.

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Formation of organic acids in salami during the early phases of ripening is highly dependent on mix characteristics and processing conditions (temperature, % R. U.) (ACTON et al., 1977; LOIS et al., 1987).

In previous works (VIRGILI et al., 1987), the production of mono-di-tricarboxylic organic acids occurring during this process together with proximate composition were related with the quality of the end-product and good agreement was obtained between sensory evaluation and classification by chemical analysis. These studies showed that the acidification pattern has important effects on the quality of the end product, since the concentration of water-soluble acids significantly affects the onset of off-flavours (sour, pungent, sweetish).

The presence of sugars in the mix and the use of different processing temperatures most influence the extent and the rate of acidification as well as the resulting pH decrease (ACTON et al., 1977; DE KETELAERE et al., 1974). In the light of recent progress in the study of salami fermentation (VIRGILI et al., 1991) the effect of two processing parameters (temperature and lactose) was invèstigated by means of technological tests with sampling and analyses being done at regular time intervals.

MATERIALS AND METHODS

Three tests were carried out in which the two parameters lactose and temperature (factors) were applied at two levels (treatments) to different mixes (formulations). The operative conditions are illustrated in Tab. 1A and 1B.

Chemical analyses: the samples, selected on the days indicated (N = 4 units per trial) were subjected to the following determinations: pH, proximate composition, water-soluble organic acids, index of acidity in fat (I.A.).

Data analysis: Analysis of variance (ANOVA) to evaluate the effects of the factors under investigation.

RESULTS AND DISCUSSION

Test 1

The simultaneous presence of the two factors, studied by means of a factorial 2x2 design with four replications for each point, allows the analysis of interactions in addition to the two main effects.

The results of statistical analysis (collected in and Tab. 2) show an increase in the main organic acids resulting from both the use of lactose and higher temperatures. In some cases, the observed pattern is just prospective, owing to the low number of degrees of freedom. Furthermore, in the case of lactic acid, data levelling on medium-high values might result from the use of a high-moisture formulation (lean meat = 80%), which is emphasized when lean cuts obtained from hypermuscular breeds are used, as was the case in this experiment. The absence of 2-way interactions witnesses the fact that the lactose-temperature effect is merely additive.

Test 2

From the mean values of the analytical parameters listed in Tab. 3 one can note that those variables which are more strictly connected with the acidification process (hydrogen ion concentration, lactic acid, acetic acid) increase significantly as a result of lactose addition. The lower production of lactic acid compared with Test 1 could be ascribed to its different mix formulation, i.e. a lower lean content.

Test 3

The test, aiming at evaluating the effects of temperature on small-sized salami, is to be related to studies on quickly-fermenting products which are in progress in the USA and in North-European countries and which are based on the use of high drying temperatures (30°C or above). The main advantage of such technique, i.e. a dramatic shortening of production times, must be weighted, in the case of Italian salami, in view of the overall sensory properties; in fact, acid tastes are to be absent in such products. According to a recent study on the fermentation chemistry of salami (VIRGILI et al., 1991) based on multivariate analysis of compounds of anaerobic glycolysis, of tricarboxylic acids and of indexes of protein and lipid hydrolysis, traditional Italian salami have a reduced content of lactic acid and acetic acid, low proteolysis indexes (N TCA) (DIERICK et al., 1974; ASTIASORAN et al., 1990) and medium-high fumaric acid levels. In the same study a correlation was found between analytical data and metabolic activities of salami typical microflora.

On the basis of such observations, treatment at 30°C seems to increase acid compounds content beyond the actual limits of Italian products. On the contrary, the use of lactose only (see test 2) results in a general acidification of the product, due to increase in lactic acid alone without significant changes in the remaining analytical variables. Lactose addition, therefore, does not seem to lead to the onset of sour or anomalous tastes which, on the contrary, could be present when high drying temperatures (27°C) are applied.

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Tab. 1A - Operating pattern

Test N°	Factors	Treatments(+)	Mince	Replications	Sampling time
1	Lactose (%)	0,1	A	2	
	Temperature (°C)	8,18			70,100
2	Lactose	0,1	B	2	70,100
3	Temperature	18,30	C	2	2, 4, 5, 10, 15

(+) Indicated as follows: Lactose (0,1) = (L-, L+). Temperature (8,18) = (T-, T+). Temperature (18,30) = (T-, T+).

Tab. 1B - Mince recipes

Formulation	A (Genoa)	B (Genoa)	D (Country)
Lean (%)	80	72	80
Fat (%)	20	28	20
Salt (%)	2.8	2.5	2.8
Sucrose (%)	0.3	0.4	0.5
Pepper (%)	0.08	0.08	0.08
$NaNO_3$ (mg/kg)	50	50	150
$NaNO_2$ (mg/kg)	100	100	100
Size (kg)	2.00	2.00	0.500

Tab. 2 - Test 1. Means of the four replications.
Differing upper letters denote significantly different means.

	L - T+	L- T-	L+ T+	L+ T-
pH	5.67	5.75	5.54	5.61
H_2O	45.76	44.54	43.90	43.98
NaCl	4.04	4.06	4.09	4.06
Fat	25.41	26.47	27.20	27.74
I.A.	15.57	14.72	15.19	14.13
N(TCA)/N(TOT)	15.01	14.30	15.07	14.61
H_2O/Prot	2.09	1.96	1.98	2.08
NaCl/H_2O	9.23	9.62	9.82	9.78
% Lactic acid	1.18	1.10	1.26	1.14
% Acetic acid	0.07	0.05	0.06	0.05
% Oxalic acid	0.03	0.02^a	0.05^b	0.03
% Pyruvic acid	-	-	-	-
% Citric acid	0.01	0.02	0.01	0.02
Fumaric acid (mg/100 g)	0.21	0.18	0.19	0.23

Tab. 2 - Test 1.
Effects of temperature and lactose and 2-way interactions.

pH	T-	T+	Lactic acid	T-	T+
L-	5.75	5.67	L-	1.10	1.18
L+	5.61	5.54	L+	1.14	1.26

Non-significant interaction — Non-significant interaction

Oxalic acid	T-	T+	Acetic acid	T-	T+
L-	0.02[a]	0.03[a]	L-	0.05[a]	0.07[b]
L+	0.03[b]	0.05[b]	L+	0.05[a]	0.06[b]

Non-significant interaction — Non-significant interaction

Tab. 3 - Test 2. Mean values of analytical data in the presence and in absence of lactose (L- e L+).
Differing upper letters denote significantly different means.

	L-	L+
pH	5.96[a]	5.57[b]
H_2O	46.06	46.79
NaCl	4.27	4.35
Fat	24.82	23.80
I.A.	16.75	17.60
N(TCA)/N(TOT)	14.50	15.60
H_2O/Prot	1.87	1.93
NaCl/H_2O	9.40	9.39
Lactic acid	0.85[a]	1.09[b]
Acetic acid	0.05[a]	0.06[b]
Oxalic acid	0.09[a]	0.13[b]
Pyruvic acid (mg/100)	7.50	6.00
Citric acid	-	-
Fumaric acid (mg/100)	-	-

Tab. 4 - Test 3. Means of the analytical parameters at 18° (T-) and 30°C (T+).
Differing upper letters denote significantly different means.

	T-	T+
pH	5.68[a]	5.38[b]
H_2O	51.52	53.05
NaCl	32.00	30.63
Fat	22.81	23.11
I.A.	21.00[a]	30.87[b]
N(TCA)/N(TOT)	12.39	13.31
H_2O/Prot	25.92	27.49
NaCl/H_2O	62.10	58.03
Lactic acid	0.86[a]	1.17[b]
Acetic acid	0.03[a]	0.14[b]
Oxalic acid	0.06	0.05
Pyruvic acid	0.009	0.006
Citric acid	0.010	0.014
Fumaric Acid (mg/100)	0.25[a]	0.07[b]