An accelerated technology for raw-dried meat products from non-comminuted meat. Changes in the carbonyl substances and the lipids

N. NESTOROV, D. GADZHEVA, M. CHAKUROV

Meat Technology Research Institute, Sofia, Bulgaria

Meat products from non-comminuted meat are calorific and preferred foods, for the high quality initial raw materials and also for the flavour qualities of the ready products. The large consumprion of this type of meat products demands the introduction of technologies shortening the periods of curing, ageing and drying.

Among the wide range of substances forming the flavour of food products, carbonyls are potential aroma substances formed above all from unsaturated fatty acids. Aliphatic monocarbonyl compounds (methyl ketones, aldehydes, 2-enals, 2,4-dienals) are very often related to off-flavour and rancidity, on the one hand, and to very desirable aromas of raw and cooled meat, on the other (Pippen, 1961; Dimick and MacNeil, 1970; Willson and Katz, 1972). Their low threshold concentrations make them important compounds to flavour even if in minimum concentrations.

The object of the present studies are the changes in the monocarbonyl compounds and the secondary products of lipid oxidation, isolated in the course of curing, ageing and drying products from non-comminuted beef and pork with a classical or an accelerated technological process.

Methods and Materials

Use was made of beef and pork muscles (M. semitendineus), which were cured by rubbing with salt, saltpetre and sugar and were processed by the method of Chakurov et al. (1979). The same raw materials, dry-cured at a temperature of 4-5 °C, were used as controls. The drying of the control samples was performed according to a technological instruction (Collection of technological instructions on the manufacture of meat products, 1977, Sofia /in Bulgarian/). The carbonyl compounds from the experimental and the control samples, extracted in the cold using perchloric acid, were converted into hydrazones, isolated and divided into classes by column adsorption chromatography and were quantified by absorption of the 2,4-$DNPH_S$ solutions in the UV region (Langner, 1971; Schwartz et al., 1963; Gadjeva et al., 1980).

The quantities of total carbonyls, monocarbonyls and their subfractions were determined by absorbing the 2,4-DNPH solutions of their derivatives using a Carl-Zeiss VSU-2P spectrophotometer and were converted into µM/g of product using the molar extinction coefficient of Jones et al. (1956).

Lipids were extracted by Bligh and Dyer's (1959) method from the experimental and the control samples. Oxidative changes were characterized by measuring the absorption of the total conjugated oxidized products in the UV region using a procedure similar to the one described by Parr and Swoboda (1976), which detects the initial stage of autooxidation. The oxodiene value (OV), as well as the conjugated oxidized product (COP_v), were determined.

Results and Discussion

The results of the analyses of the total and monocarbonyl compounds are shown in Tables 1 and 1a, for the beef and pork raw material, respectively. Changes in the lipids during ageing and drying are demonstrated in Figs. 2 and 2a.

Table 1. Changes in the monocarbonyls isolated from beef in the manufacture of raw-dried meat products from non-comminuted meat using a classical or an accelerated technology

Sample		Total Carbonyls	Monocarbonyls µM/g	Methyl Ketones	Aldehydes	2-enals	2,4-dienals
Uncured meat		370	9,9	7,0	1,5	0,5	0,9
2nd day	exp.	390	10,8	7,9	1,6	0,4	0,9
	contr.	380	9,1	7,9	1,0	0,1	0,1
6th day	exper.	730	28,0	20,8	6,1	0,7	0,4
	contr.	640	16,0	12,1	1,4	0,3	0,2
15th day	exper.	1000	220,0	50,0	67,0	33,1	70,0
	contr.	730	36,5	12,4	10,0	4,2	9,9
28th day	exper.	780	130,0	66,0	39,0	15,0	4,4
	contr.	740	50,0	25,1	16,0	5,0	3,9
48th day	contr.	690	120,0	59,0	36,0	15,0	10,0

As can be seen from Table 1, total carbonyls and monocarbonyls demonstrate a tendency towards an increase, which is more significant in the period between the 6th and 15th day of product drying and ageing. In experimental samples, this tendency is more pronounced. Both total and individual monocarbonyl fractions exhibit maximum quantities on the 15th day in the experiment, while in the controls, this process is more delayed. Probably the change in temperature in the accelerated technological regime has contributed to this effect.

The low content of the unsaturated subfractions of monocarbonyls is obvious in the uncured raw material and in the cured material on the 2nd and the 6th day of the technological pro-

cess, compared to the amounts of methyl ketones and aldehydes.
The unsaturated subfractions of the experimental sample are about 8 times as high as the control on the 15th day of drying, which is confirmed also by the values obtained for the conjugated oxidized product (COP_v) and the oxodiene value (OV), a measure of unsaturated carbonyls, shown in Fig. 2. By the end of the drying process, total carbonyls and aliphatic monocarbonyls of the experimental and the control samples show a tendency towards equalizing, what was confirmed also by the organoleptic evaluation of the finished product by the 9-score hedonic scale (7,55 for the experimental sample, and 7,4 for the control). The experimentally determined reduction in total carbonyls and monocarbonyls in the experimental and control finished products, compared to the 15th day of the technological regimens, is explained by the degradation of meat proteins and lipids, the probable precursors of monocarbonyl compounds.

Table 1a. Changes in the monocarbonyl compounds isolated from pork in the manufacture of raw-dried meat products from non-comminuted meat using a classical or an accelerated technology

Sample	Total Carbonyls	Monocarbonyls	Methyl Ketones	Aldehydes	2-enals	2,4-dienals
			µM/g			
Uncured meat	600	20,0	10,0	7,0	2,5	-
1st day	620	23,5	10,5	8,5	2,5	2,5
6th day exper.	1000	41,0	20,0	12,0	5,0	4,0
contr.	920	80,8	40,8	30,0	10,0	0,8
15th day exper.	1220	295,0	102,0	98,0	55,0	40,0
contr.	1100	90,0	20,0	42,0	15,0	13,0
16th day exper.	1010	155,0	90,0	42,0	18,0	5,0
26th day contr.	980	152,0	89,0	40,0	12,5	10,0

It becomes clear, that in pork, as also in beef, a tendency is observed towards an increase in the amounts of total and monocarbonyl compounds in the process of drying. The surge in the amounts of these compounds in the control on the 6th day is of interest, compared to the experimental sample in which quantities are twice as high almost everywhere. This fact suggests the good penetration of curing agents into meat cuts of the experimental sample, resulting

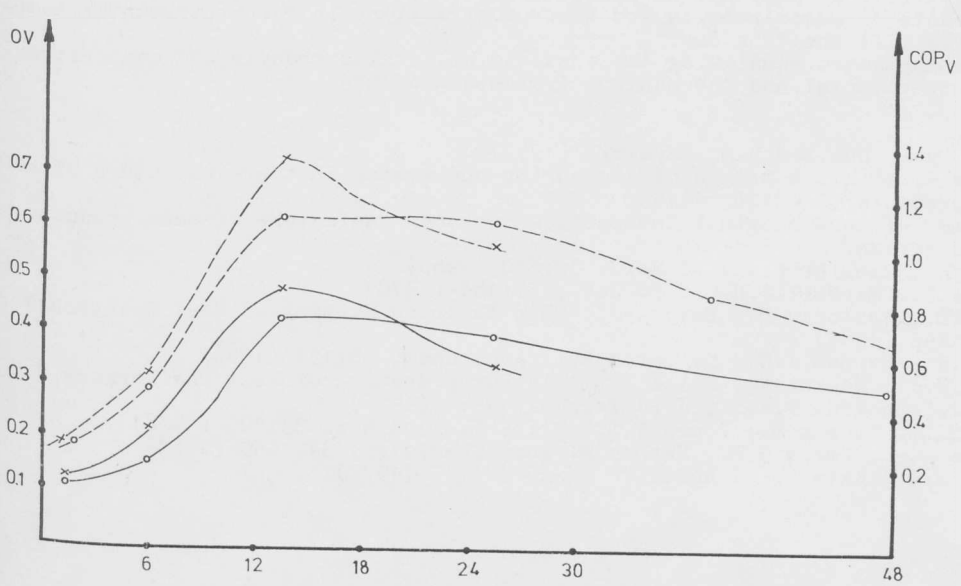

Fig. 2. Changes in the lipids of beef during processing

—— o OV, Control ---- o COP_v, Control
—— x OV, Experimental Sample ---- x COP_v, Experimental Sample

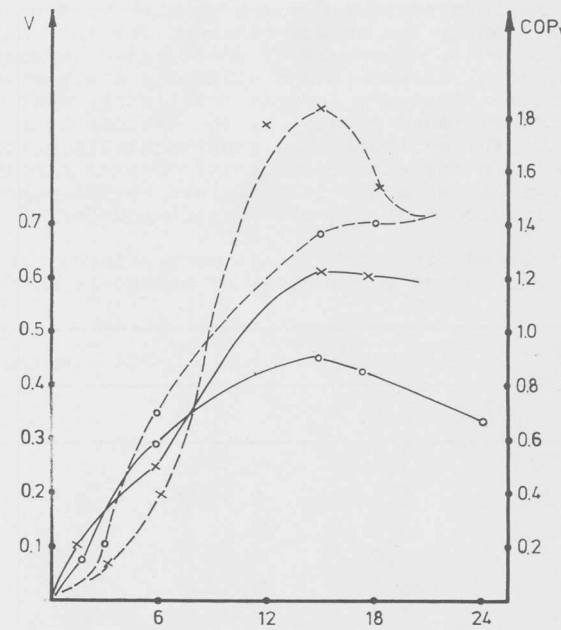

Fig. 2a. Changes in the lipids of pork during processing

—— o OV, Control
—— x OV, Experimental Sample
--- o COP_V, Control
--- x COP_V, Experimental Sample

in a delay in fat oxidation (Cross, Ziegler, 1965). It is worth noticing that, while total carbonyls in sample and control change comparatively uniformly in the course of drying, no such thing can be said of the monocarbonyls. The technological regime exerts a marked influence on this type of compounds, especially in the period between the 6th and 15th days, where the amounts of monocarbonyl substances and their subfractions in experimental samples rise sharply. It should also be noted, that in the pork raw material, due to the higher fat percentage, the amounts of carbonyl substances are greater compared to those in beef. A similar trend is observed here, towards equalizing the amounts of monocarbonyls and their subfractions, and also of the lipid oxidation products in the finished products of the experimental and control samples. The organoleptic score of the experimental sample is 8,1, and of the control, 8,0. The data of the analysis of monocarbonyls and their subfractions in the pork raw material coincide well also with the values found for the conjugated oxidized product (COP_V) and the oxodiene value (OV), expressed graphically in Fig. 2a. COP_V in pork is higher than COP_V in beef, what speaks for the higher degree of oxidation of lipids, the same being true also of the experimental values of OV. In contrast to beef, a greater oxidation is found in the pork control on the 6th day of ageing, which demonstrates the positive effect of the good penetration of curing agents in the accelerated technological regimen.

Conclusions

(1) The accelerated technology of manufacturing meat products from non-comminuted meats does not affect adversely the flavour of the finished product.

(2) In the accelerated technology, oxidative processes are slowed down till the 6th day in pork raw material, as a result of the better penetration of curing materials.
(3) The amounts of monocarbonyls and their subfractions in the experimental samples increase progressively till the 15th day.
(4) A tendency toward equalizing the contents of total carbonyls and monocarbonyls is observed in the experimental and the control finished products.

References

1. Bligh & Dyer. Con.Biochem. Physiol. (1959)
2. Chakurov M. et al. A method of dry curing and ageing in the manufacture of non-comminuted meat products (P 43125, 1975)
3. Collection of technological instructions on the manufacture of meat products, Sofia,(1977) /In Bulgarian/
4. Cross C.K., Ziegler P., J.Fd Sci., 30:610 (1965)
5. Dimick P.S., MacNeil J.H., J.Fd Sci., 35:186 (1970)
6. Gadjeva D., Nestorov N., Baychev I. 26th European Meeting of Meat Research Workers, V.2, L-23, 196 (1980)
7. Jones L.A., Holmes J.C., Seligman R.L. Anal.Chem. 28:191 (1956)
8. Langner H.J., Heckel V., Malek E. 16th Europ.Meeting of Meat Res.Workers C:631 (1970)
9. Parr L.J., Swoboda P.A.T., J.Fd Technol. 11:1 (1976)
10. Pippen E.L., Nonaka M., Jones F.T., Stiff F. Food Res. 23:103 (1958)
11. Schwartz D.P., Parks O.W., Keeney M. Anal.Chemistry, 34, 669 (1963)
12. Willson R.A., Katz I. J.Agric.Fd Chem. 30:741 (1972)