CHECKING OF FERMENTED SAUSAGES FOR "COMPLETE TREATMENT" ACCORDING TO THE EEC-DIRECTIVE 77/99/EEC

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INTRODUCTION

Having regard to the Council Directive (77/99/EEC) a salted, cured and/or dried meat product has undergone complete treatment when:

a) the a_w value does not exceed 0.91

b) the pH value is less than 4.5

c) the a_w value does not exceed 0.95 in combination with a pH value not higher than 5.2

All meat products meeting at least one of the given criteria are allowed to be stored at room temperature (not refrigerated).
Incompletely treated products which do not meet one of the above mentioned criteria are to be labelled for maximal storage temperature and shelflife.
To ensure that the effectiveness of the treatment of commercially produced dry sausages is in compliance with the above mentioned criteria, different batches were examined according to the reference method as described in the revised draft of 29.05.1979.
At the same time, comparative a_w determinations based on alternative measuring principles were also performed.

MATERIALS AND METHODS

From two local factories consignments of 9 different types of dry sausage were sampled by taking 3 sample units (sausages) each from the finished batches.
Some major informative data from these consignments given by the producers are summarized in TABLE 1.

TABLE 1 : Information given by the producers on the composition and processing of the sausage mixtures used in the experiments

Consignment number	Size Ø in cm	Pork fat (%)	NaCl (%)	Days of aging	Shrinkage (%)	Type of casing
1	9	32	2.9	28	22	Collagen (Naturin R2)
2	14	30	2.9	13	10	Cellulose-fibrous SL
3	10.3	30	2.9	30	23	Natural pork casing
4	15.5x10.5	30	2.9	14	11	Cellulose (Nalo FJ)
5	8.5x8.5	30	2.9	21	19	Natural pork casing
6	7.4	9	2.9	22	23	Natural pork casing
7	7.5	30	2.9	25	24	Collagen (Naturin R2)
8	7.5	25	2.8	60	29	Natural pork casing
9	15.0x10.0	25	2.8	13	16	Synthetic casing

Sampling procedure for measuring water activity

Water activity values were determined on both the centre and surface region. All samples were 28 mm. diameter cores taken from both sites. Whereas the samples from the centre were entirely used the surface cores were halved and a_w measurements were performed on the outside parts only.
The laboratory samples were not homogenized but immediately put in a closed container and equilibrated for sufficient time to reach a temperature of 25°C ±0.2°C before the a_w-values were measured.

Determination of water activity

a- The non-homogenized samples from the centre and surface region were placed in a holder and the sensor of the ROTRONIC DT device, previously calibrated with different sodium chloride solutions, was mounted during 4 hours (4) (=reference method).

b- 50-60 gram samples from either the surface or the centre region were also placed in a small humidity chamber. The water activity was measured by means of the isopiestic method, using pregelatinized corn starch as adsorbant (5).

c- On the basis of the analytical data for water and sodium chloride content, water activity values of the surface samples were calculated according to the procedure proposed by DEMEYER (1).

pH-Measurements

The pH from centre and surface samples was measured by direct insertion of a combined electrode (INGOLD 404). The electrode was connected to a KNICK-pH meter PORTAMESS 902.

Chemical analyses

The finished products (surface) were analysed for moisture content (ISO 1442-1973) and sodium chloride concentration (ISO R1841-1970).

Enumeration of Staphylococci

0.1 ml of diluted homogenates (1/10) from surface and centre samples were inoculated in duplicate on BAIRD-PARKER Medium (OXOID CM275).

RESULTS

Analytical data for moisture content and sodium chloride concentration of the surface samples from the finished products are given in TABLE 2. In this table a_w values which have been calculated from these data are also presented.

The combined values for a_w and pH from both the centre and surface samples are summarized in TABLE 3. In evaluating these combined results according to the criteria given by the EEC Directive, the most unfavourable combination of results obtained on one of both sampling sites (centre or surface) must be used as criterion for accepting or rejecting a consignment. This means that, in monitoring the acceptability of a consignment of dry sausages, the water activity of the centre is most important.

Comparison of the a_w values obtained with the isopiestic method with the values recorded by an electric hygrometer (ROTRONIC DT) indicates that both the accuracy and repeatability of the isopiestic method are as high as for the electric hygrometer which has been proposed as reference technique.

On the other hand calculation of the a_w value from the analytical data for moisture and salt content was shown to be less reliable since at a low a_w range water activity was clearly overestimated by this procedure (cf. TABLE 3, consignments 3, 6, 7 and 8).

TABLE 2 : Analytical data for moisture and salt content of the finished products and calculated a_w values derived from these data (n.d. = not determined) (surface samples)

Consignment number	Sample number	Moisture content (%)	Sodium chloride (%)	Calculated a_w value
2	1	46.46	3.23	0.939
	2	45.18	3.29	0.937
	3	46.80	3.26	0.939
3	1	38.29	3.45	0.927
	2	36.70	3.49	0.924
	3	38.39	3.59	0.925
4	1	46.85	3.33	0.938
	2	46.66	3.51	0.936
	3	45.55	3.21	0.938
5	1	46.41	3.32	0.938
	2	45.72	3.44	0.936
	3	46.61	3.36	0.938
6	1	44.25	4.02	0.926
	2	44.48	3.87	0.928
	3	43.78	3.80	0.929
7	1	39.68	4.27	0.916
	2	36.64	3.86	0.917
	3	39.99	3.86	0.923
8	1	38.75	4.03	0.918
	2	39.71	4.09	0.919
	3	39.09	4.14	0.917
9	1	47.91	3.15	0.941
	2	46.78	3.22	0.939
	3	n.d.	n.d.	n.d.

TABLE 3 : Combined pH and a_w values for centre and surface samples from 9 different consignments of dry sausages examined according the the EEC proposal from 29.05.1979

Consignment n°	Sample n°	centre pH	centre a_w (Rotronic)	centre a_w (isopiestic)	surface pH	surface a_w (Rotronic)	surface a_w (isopiestic)	surface a_w (calculated)
	1	4.7	0.935	0.931	4.8	0.922	0.917	n.d.
1	2	4.6	0.928	0.928	4.7	0.913	0.912	n.d.
	3	4.6	0.929	0.930	4.7	0.913	0.912	n.d.
	1	4.7	0.947	0.949	4.7	0.938	0.935	0.939
2	2	4.6	0.950	0.954	4.7	0.941	0.939	0.937
	3	4.7	0.949	0.953	4.8	0.940	0.938	0.939
	1	4.6	0.929	0.930	4.7	0.916	0.911	0.927
3	2	4.6	0.926	0.930	4.8	0.916	0.912	0.924
	3	4.7	0.925	0.928	4.8	0.912	0.905	0.925
	1	4.7	0.953	0.951	4.7	0.940	0.939	0.938
4	2	4.7	0.950	0.955	4.8	0.942	0.941	0.936
	3	4.7	0.947	0.950	4.8	0.937	0.939	0.938
	1	4.6	0.946	0.947	4.6	0.935	0.934	0.938
5	2	4.6	0.945	0.946	4.7	0.935	0.930	0.936
	3	4.6	0.944	0.948	4.7	0.928	0.933	0.938
	1	4.9	0.935	0.929	5.0	0.920	0.918	0.926
6	2	4.9	0.932	0.932	5.0	0.921	0.924	0.928
	3	4.8	0.935	0.933	5.0	0.919	0.921	0.929
	1	4.7	0.915	0.913	4.8	0.901	0.901	0.916
7	2	4.8	0.916	0.915	4.9	0.902	0.902	0.917
	3	4.8	0.922	0.918	4.9	0.908	0.903	0.923
	1	4.9	0.907	0.910	5.1	0.891	0.905	0.918
8	2	4.9	0.908	0.912	5.1	0.897	0.906	0.919
	3	4.8	0.910	0.916	5.0	0.900	0.907	0.917
	1	4.6	0.954	0.962	4.8	0.943	0.952	0.941
9	2	4.6	0.953	0.960	4.8	0.941	0.945	0.939
	3	4.6	0.956	0.959	4.9	0.946	0.946	n.d.

Considering the permitted tolerances for product a_w values, the revised draft from 29.05.1979 stipulates that one laboratory sample must not exceed the limit a_w value + 0.02 a_w (= 2 times the measuring error tolerance), while the remaining two values must not exceed the limit a_w value + 0.01 a_w (= 1 time the measuring error tolerance).

With reference to these tolerances all examined consignments were qualified as completely treated in accordance with the criteria of the Council Directive.

Only two consignments (n° 7 and 8), showing the highest figures for shrinkage (respect. 24 % and 29 %), yielded a_w values in the centre of the product which were sufficiently low in order to comply with criterion a) of the present Directive ($a_w \leq 0.91$).

However, monitoring of shrinkage without any knowledge regarding the composition of the sausage mixture, cannot be used as a reliable parameter in predicting the a_w range of the product. Comparing the amount of fat added to the sausage mixtures and shrinkage of consignments 6 and 7 with the respective analytical data and a_w values recorded, it is obvious that an estimation of the a_w value of the finished product is only feasible on condition that information on the fat content is available. This clearly demonstrates the indirect effect of fat content on the a_w value of meat products (6).

None of the samples were in compliance with criterion b) of the Directive (pH < 4.5).

However, when using the combined results for a_w and pH (criterion c), all examined consignments were qualified as acceptable according to the Directive.

Depending on the size and diameter of the sausages, some large graded products (e.g. consignments 2, 4 and 9: see table 1) did meet the latter criterion only by application of the permitted tolerances for the a_w measurements (electric hygrometer and isopiestic method).

Lecithinase positive staphylococci could not be isolated in any of the consignments (less than 50 cells per gram). These findings support the fact that the listed criteria are assumed to be inhibitory for the growth of S. aureus.

Experiments published by RIEMANN (3) showed that growth of S. aureus (inoculum 1.0×10^7 cells per ml) occurred at a_w and pH values of the medium of respectively 0.945 and 4.5.

However, the results of these experiments are not in contradiction with those of the present study since growth is not only related to physico-chemical parameters such as a_w and pH but also to other criteria such as the number of inoculated cells and the presence of other "hurdles" (nitrite concentration, competitive microflora etc.) (2).

Furthermore , it has been reported by LEISTNER (2) that some a_w tolerant micro-organisms e.g. S. aureus may already be inhibited at pH 5.0.

CONCLUSIONS

The effectiveness of treatment of all consignments of dry sausages examined was in compliance with the criteria given in the Directive 77/99/EEC.
Due to the application of tolerances for a_w and pH, however, consignments of dry sausages containing sample units with an a_w value 0.97 and pH value 5.4 (limit values + 2 times the measuring error tolerance) are likely to be considered as completely treated.
This a_w-pH combination is already obtained within 3 to 5 days of aging. At that time there is still a hazard for multiplication of some micro-organisms such as S. aureus. For that reason the application of the proposed measuring tolerances is questionable. The limit values for a_w and pH should therefore be considered as absolute limit values which may not be exceeded by any of the laboratory samples. This applies particularly for the combined values (criterion c). Otherwise the application of more stringent tolerances has to be considered.

Apart from the reference method (electric hygrometer), other principles for measurement of water activity giving the same standard deviations can be used. In this study the results obtained with the isopiestic method are in compliance with the a_w values recorded with the reference method.
On the other hand the calculated a_w values are not reliable. At the critical a_w value 0.91 the calculated values are overestimated whereas at the a_w value 0.95 there is a slight underestimation.

LITERATURE

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