DIE UNTERSUCHUNG EINIGER RAUCHKONDENSATE

Birgitta Berger, Lennart Hemrå und Roy Nilsson

Die Schwedische Fleischforschungsanstalt
244 00 Kävlinge, Schweden

Neun Rauchkondensate und ihre Phenolfraktione wurden durch Gaskromatografi untersucht. In einer sensorischen Untersuchung wurden die gleichen Rauchkondensate einerseits zu Bolognawurst, anderseits zu Schweineschmalz zugesetzt. Die Ergebnisse dieser Untersuchung wurden mit den Ergebnissen der chemischen Untersuchung verglichen.

Vier der Kondensate haben acceptierbare Würste ergeben. Die Qualität der Rauchkondensate war nicht in grössem Masse von der Zusammensetzung der Phenolfraktion abhängig, sondern vom Verhältnis der Phenol- und Nichtphenolverbindungen.

Die Anwendung von Modellsystemen wie Suspensionen von Rauchkondensaten in Schweineschmalz können zu irrtümlichen Ergebnissen ihrer Geruchqualitäten führen. Man hat die Frage aufgeworfen, ob Geruch und Geschmack von Rauch für die organoleptische Qualität von Bologna und anderer Brühwürste wichtig ist.

L'ÉVALUATION DE QUELQUES CONDENSATS DE FUMÉE

Birgitta Berger, Lennart Hemrå et Roy Nilsson

L'Institut de recherche sur les viandes de boucherie
244 00 Kävlinge, Suède

Neuf condensats de fumée et leurs fractions de phénol ont été analysés par chromatographie en phase gas-liquide.

Les résultats ont été comparés avec une évaluation sensorielle des mêmes condensats qui ont été ajoutés à une saucisse de Bologne ou souspendus dans du lard raffiné.

Quatre des condensats ont donné une saucisse qui était acceptable. La qualité des condensats n' était pas particulièrement dépendante de la composition de la fraction phénolique mais dépendait de la balance entre les composants phénoliques et non-phenoliques (composants acides et carbonyliques).

La suspension des condensats de fumée dans le lard peut donner des resultats décevants en ce qui concerne la qualité de l'arom des condensats. La question de l'importance de l'arom de la fumée pour l'arom total de la saucisse de Bologne ce pose.

THE EVALUATION OF SOME SMOKE CONDENSATES

Birgitta Berger, Lennart Hemrå and Roy Nilsson

Swedish Meat Research Centre
244 00 Kävlinge, Sweden

Nine smoke condensates and the phenol fractions extracted from them have been analysed by gas-liquid chromatography.

The results have been related to a sensoric evaluation of the same smoke condensates added to a sausage of Bologna type or suspended in refined lard.

Four of the condensates gave a sausage which was acceptable.

The quality of the smoke condensates was not to any great extent dependent on the composition of the phenolic fraction but on the balance between the phenolic and non-phenolic compounds (acid and carbonyl compounds).

The use of model systems like suspensions of smoke condensates in lard may give misleading results of their flavouring qualities.

The question was raised if smoke flavour is important to the total flavour of the Bologna type of sausage.

ОЦЕНКА НЕКОТОРЫХ КОПЧЁНЫХ КОНДЕНСАТОВ

Биргита Бергер, Ленарт Гемро и Рой Нильссон

Шведский институт по исследованию мяса
244 00 Чевлинге, Швеция

На девяти копчёных конденсатов и экстрагированных из них фракции фенола был проведен анализ с помощью газо-жидкостной хроматографии.

Результаты анализа были соотнесены с оценкой по вкусовым качествам этих копчёных конденсатов, смешанных с Болоньской колбасой или взвешенных в топлёном свином жиру.

Четыре конденсата дали колбасу, приемлемую для употребления.

Качество копчёных конденсатов не зависело в какой либо степени от состава фракции фенола, но зависело от пропорции между компонентами фенола и не-фенола (кислового и углевого компонентов).

Употребление дисперсных систем, как суспензии копчёных конденсатов в топлёном свином жиру, относительно их привкуса, могут дать ошибочные результаты.

Был поставлен вопрос о том, является ли привкус копчёности важным для вкуса Болоньской колбасы в целом.

THE EVALUATION OF SOME SMOKE CONDENSATES[x)]

Birgitta Berger, Lennart Hemrå and Roy Nilsson

Swedish Meat Research Centre
244 00 Kävlinge, Sweden

INTRODUCTION

In the manufacture of meat products smoking is an important flavouring process. Ordinary smoke consists of a large number of compounds from different chemical classes as shown by several investigations carried out during the last 10-15 years (see amongst others Hruza et al. (5)).

The most frequent compounds in smoke can be classified into three groups: phenols, acids and carbonyl compounds, each of them having important functions in the smoking process. The phenols seem to be of dominating importance to the smoke flavour, as, according to Bratzler et al. (1), they account for about 70% of this flavour. The corresponding contribution of acids and carbonyl compounds is about 25% together.

Lately most of the interest concerning the smoking process has been concentrated on the possibilities of having a process which is more rational than the present one and which also gives a product with a more uniform smoke flavour and with as low a concentration as possible of polycyclic hydrocarbons.

For that purpose a lot of different smoke condensates or liquid smokes have been produced. They are to be used in sausage production either as an addition in the cutter or by spraying them on the heating elements in a smoking chamber.

Analytical work carried out on smoke condensates has shown that they contain the same compounds as ordinary smoke (Lagner (6), Fiddler et al. (2), Gorbatov et al. (4)). But depending on the type of wood used and the method of preparation the quantitative composition as well as some functional properties of the smoke condensates may differ from brand to brand as shown by Gorbatov et al. (4).

What is more interesting than the actual chemical composition of the smoke condensates, however, is the influence of their composition on the flavour of sausages to which they have been added. Only a few papers seem to have dealt with this problem. Thus, Fiddler et al. (3) and Potthast (7) found that a combination of phenols and carbonyl compounds was necessary to get an acceptable smoke flavour in the meat products. But if, as has been reported by Gorbatov et al. (4) the phenols are quantitatively dominating in the smoke condensates, the flavour will be undesirable. Further investigations are obviously needed if the practical usefulness of a smoke condensate is to be correctly assessed.

x) Independant of mode of preparation all the samples tested are in this paper called smoke condensates.

In the present work the composition of the phenol fraction of nine smoke condensates has been determined by gas-liquid chromatography and the same method has been used to get an overall picture of the composition of the condensates.

The chromatographic data have been compared with the results of a sensoric evaluation of sausages to which the condensates have been added. A further sensoric evaluation was carried out with suspensions of the condensates in lard.

MATERIAL AND METHODS

Smoke condensates. Nine different brands (A-I) of smoke condensates were used in this investigation. Three of them, B, C and F were obtained as fat-emulsions, the others as suspensions in water.

Analysis by gas-liquid chromatography. The phenol fraction was extracted from the condensates by ether. The ether solution was dried with sodium sulphate and then evaporated in nitrogene atmosphere to a volume suitable for analysis by gas-liquid chromatography. The analysis was performed with a Varian Aerograph 2700 gas chromatograph using a 6'x 1/8" stainless steel column packed with 5% Carbowax 20 MTPA on 100-200 mesh of Chromosorb W H.P. The injector temperature was 210-230°C, and the detector temperature 230°C. The column temperature was held at 100°C for the first 10 minutes of a run and then increased by 4°C per minute up to 220°C. The same conditions were used for the chromatography of the unfractionated smoke condensates.

The identification of some of the peaks was based on the retention times in comparison with authentic substances. For quantitative measurements the area under the peaks was used. The measurements were carried out by an electronic integrator, Varian Aerograph 475. A detailed description of the analytical procedure will be given elsewhere.

Sensory evaluation test. The taste panel consisted of 8 members who have been testing sausages for several years. They were rating the following properties: smoky, tarry, burnt, sweet, sour, solvent and unidentified off-flavour. A 6-point scale, 0-5 was used. The panelists were also asked to give an overall rating; good, acceptable or not acceptable.

The rating of the smoke concentrates was carried out in two ways:

1. They were done on Falu-sausage (a sausage of Bologna type with a diameter of 40 mm) to which the concentrates were added in about the amounts recommended by the producer. As a reference a sample smoked in the ordinary way was used.
2. The rating was also done on suspensions of the smoke condensates in refined lard.

RESULTS AND DISCUSSION

The composition of the phenol fraction. The results of the analysis by gas-liquid chromatography of the phenol fraction from the different smoke condensates are shown in table 1.

Peak compound \ Condensate	% area								
	A	B	C	D	E	F	G	H	I
1. Unidentified	1.5	-	3.4	5.9	22.2	4.0	10.4	-	6.3
2. Guiacol	22.6	18.4	46.0	13.0	4.9	16.3	9.7	3.8	5.1
3. Unidentified	1.8	-	-	2.4	3.9	1.7	1.9	-	-
4. Creosol	34.7	34.1	0.3	6.3	2.9	8.3	5.2	6.6	1.2
5. Phenol	5.3	4.6	4.2	8.1	10.7	9.5	5.0	7.2	-
6. Unidentified	11.1	14.6	-	1.0	0.1	2.0	0.7	2.7	-
7. p-Cresol	6.4	7.3	1.5	4.5	4.1	5.8	2.4	9.8	14.2
8. propyl-guiacol	0.7	2.5	-	-	-	0.1	-	-	-
9. 2,3-xylenol									
10. Eugenol	2.9	4.6	-	0.6	0.2	1.0	0.2	5.3	-
11. Syringol	2.1	3.5	11.4	31.4	16.6	22.0	18.4	24.2	27.9
12. i-Eugenol	6.4	8.4	4.6	15.5	4.7	12.1	10.5	16.4	7.8
13. Unidentified	-	-	0.4	4.3	1.5	4.0	2.4	5.4	1.2
14. Unidentified	0.3	-	2.3	0.5	0.1	0.4	1.0	-	10.4
15. Unidentified	-	-	7.7	0.1	0.6	0.2	2.9	-	1.1
16. Vanillin	2.4	1.2	10.6	1.3	1.5	0.9	3.0	9.7	16.0
17. Unidentified	0.2	-	-	-	18.2	0.9	9.7	-	-
18. Unidentified	-	-	-	0.3	0.4	0.4	2.4	-	2.4

Table 1. Components in the phenol fraction from smoke condensates as analysed by gas-liquid chromatography.

Of the 18 peaks found in the chromatograms 9 were identified as guiacol (2), creosol (4), phenol (5), p-cresol (7), propyl-guiacol (8), eugenol (10, syringol (11), isoeugenol (12) and vanillin (16). Peak no. 9, 2,3-xylenol, was used as an internal standard.

The condensates could be arranged in three groups according to which peaks dominated the chromatograms.

1. One group was dominated by the peaks 1-8 caused by substances with a more or less pure phenolic flavour. To this group belong the smoke concentrates A, B and C.
2. One group consisted of the brands D, G, H and I. The peaks 10-17 caused by compounds with an aromatic or sweet flavour were dominating within this group.
3. One group with a rather even distribution of the peaks over the whole chromatogram was formed by smoke condensates E and F.

Analysis of the unfractionated smoke condensates. As mentioned in the introduction there are other compounds besides the phenols which contribute to the smoke flavour. To get a rough estimation of the relative proportions between phenols and non-phenols the unfractionated smoke condensates were analysed by gas-liquid chromatography in the same way as the phenol fractions.

The chromatograms of the total smoke condensates contained only 7-8 larger non-phenolic peaks; one of them was identified as acetic acid. In each smoke condensate it was generally only 2-3 peaks that dominated.

But even if the non-phenol group was made up of only a few larger peaks, these constituted in some cases (A, C, D and I) a large part of the condensates as shown in table 2. In other cases, however, they amount to only a small proportion (F and H).

Smoke condensate	A	B	C	D	E	F	G	H	I
% non-phenolic compounds	>95	30-40	>95	85-95	60-70	5-10	65-70	20-30	80-90

Table 2. The relative concentration of non-phenolic compounds in smoke condensates. The values are obtained by measurements of peak areas in gas-liquid chromatograms.

It should be emphasized that the results in table 2 are expressed as the percentage of the total area covered by non-phenolic peaks. Therefore, the figures given may not reflect the true concentrations. But the values could be used to compare different smoke condensates.

Sensoric evaluation of smoke condensates in sausages. The sensoric rating was carried out on two batches of Falu-sausage. Each batch was rated twice with two days between the testing. The mean values from the four ratings were calculated and then recalculated so that the relative point for smoky flavour was 1 for all the condensates. This made it easier to compare the different samples as in this way it was possible to compensate for minor differences in the flavour intensities.

Two references were used. One was sausages smoked in a smoking chamber and one was a sausage which had only been cooked and therefore should not have any smoke flavour.

The smoke condensates are arranged in table 3 according to the overall rating. The overall rating for the references was "good" and the same rating was also obtained for products containing the smoke condensate C. The overall rating "acceptable" was given for the condensates B, E, G and I.

Sample	Overall rating	Relative points for					
		Smoky	Tarry	Burnt	Sweet	Sour	Unidentified off-flavour
Reference	good-accept.	1	0.2	0	0.06	0	0
C	"	1	0.06	0	0.3	0	0
unsmoked reference	"	1	0.08	0	0.3	0	0
E	accept.	1	0.2	0	0.2	0.05	0
I	"	1	0.2	0	0.3	0	0.04
G	"	1	0.4	0	0.3	0	0
B	"	1	0.7	0	0.2	0	0
C (high conc.)	not accept.	1	2.6	0	1.3	1.6	0.9
C (phenol-fract.)	"	1	0.8	0	1.0	0.4	0.4
C (non phenol-fract.)	"	1	0.1	0	0.3	0	0.5
D	"	1	0.3	0	0.6	0.8	0.3
A	"	1	0.2	0	1.0	1.0	0
F	"	1	0.7	0.7	1.1	0	0.1
H	"	1	2.4	0	0.9	0.2	0

Table 3. Sensoric evaluation of smoke condensates added to sausage of Bologna type. Results are given as overall ratings and points relative to a value of 1 for smoky flavour.

With the exception of condensate C all the acceptable condensates were characterized by a relative point for tarry flavour between 0.1 and 0.7 and by the absence of higher relative points for sweet, sour and unidentified off-flavour. The point for tarry flavour may be taken as a criterion for a real smoke flavour in the product. The overall rating "good" for the unsmoked reference was interesting and is consistent with what we have found several times in other projects dealing with the smoking process. The findings indicate that with the product type used here the smoking process may be of minor importance to the flavour

This may imply that the rating "good" for condensate C depends on the fact that this condensate gives the product neither a smoke flavour nor any off-flavour in the concentration used. Actually, the relative points for tarry were very low both for condensate C and for the unsmoked reference and they also had almost identical absolute ratings pointing to the absence of a real smoke flavour.

If condensate C was added in such a quantity that according to gas-liquid chromatography the phenol concentration was about the same as with the other condensates the relative point for tarry flavour increased considerably. At the same time the points for sweet, sour and unidentified off-flavours also increased. The consequence was that the sausages were no longer acceptable to the consumer.

An acceptable smoke flavour was obtained neither when only the phenol fraction nor when the non-phenol fraction was used.

The characteristics of the smoke condensates which did not give acceptable products (A, D, F and H) were high relative points for sweet and sour flavour sometimes combined with high points for tarry and burnt flavour.

A combination of the results in table 1 and 3 reveals that the composition of the phenol fraction seemed to be of minor importance to the quality of the smoke condensates. All the three groups mentioned above were in fact represented amongst both the condensates rated as "good" or "acceptable" and those rated as "not-acceptable".

More important to the quality of the condensates than the composition of the phenolic fraction is the proportion between phenolic and non-phenolic fractions, as could be seen by comparing table 2 and 3.

In all the accepted condensates the content of non-phenolic compounds amounted to between 35 and 80% of the organic material - calculated as peak areas. This implies that there should be some balance between phenols on one hand and acids and carbonyl compounds, the main components in the non-phenolic fraction, on the other.

The condensates A and D had a relative content of non-phenolic compounds higher than 80% giving sausages very high relative points for sour. Since this flavour is not desirable in the type of sausages used for the testing these condensates were consequently rated as "not acceptable".

The condensates F and H had a low proportion of non-phenolic compounds. This means of course that they had a high relative concentration of phenols which gave the sausages a too strong tarry or burnt flavour. They were subsequently rated as "not acceptable".

The results discussed above refer to hot-smoked and cooked sausages of Bologna type in which usually the smoke flavour is not very pronounced. It is possible that the rating will be different if the condensates are added to cold-smoked sausages like different types of Metwurst. A strong smoke flavour is desirable in these products and therefore the consumer may tolerate a higher degree of tarry flavour in them. Further, since these sausages have a low pH, an acid flavour induced by some of the condensates may be of no harm.

Sensoric evaluation of smoke condensates suspended in lard. Instead of using sausages for sensoric evaluation of smoke condensates a simple model system consisting of suspensions of the condensates in refined lard was also tried.

Sample	Overall rating	Relative points for					
		Smoky	Tarry	Burnt	Sweet	Sour	Unidentified off-flavour
H	acceptable	1	1	0.4	0	0.4	0
F	"	0.7	1	0	0	0	0.3
G	accepted with doubtfulness	2	1	0	0	3	0
B	not accepted	0.5	1	0	0.5	0.5	0
A	"	0	1	0	0	0	0.7
C	"	0	1	0	4	3	0
E	"	0.4	1	0	0.2	0.6	0
D	"	0.7	1	0	0.7	0	0

Table 4. Sensoric evaluation of smoke condensates suspended in refined lard. Overall rating and points relative to a value of 1 for tarry flavour.

The results are shown in table 4. As with sausages they are given as an overall rating and as relative points. But since some of the condensates did not give any smoke flavour to the lard the points were recalculated to a value of 1 for tarry flavour instead of smoky.

The condensates F and H which according to table 2 had a high proportion of phenols were rated best contrary to what was found with sausages. Consequently, the condensates A, C and D were rated low as they contained only a small proportion of phenols.

But even a condensate with "balance" between phenols and non-phenols was rated as "not acceptable" (E). The reasons for this seemed to be the rather strong sour flavour given by it and easily recognized in the lard. In a sausage the sour flavour may be partly or completely marked.

The results show that this type of model system does not give results of practical value for the evaluation of smoke condensates. On the contrary, they can give misleading results.

Conclusions. The following conclusions may be drawn from the results:

- It is possible to obtain an acceptable sausage of Bologna type by using smoke condensates as additives. But the question arose whether a smoke flavour is really necessary to get a consumer's acceptance of the product.
- The suitability of a smoke condensate depends not so much on the composition of the phenol fraction as on the relative concentrations of phenols and non-phenolic compounds (mainly acids and carbonyl compounds).
- The proportion between phenolic and non-phenolic compounds as measured by gas-liquid chromatography peak areas may be used as a rough estimate of the flavour quality of smoke condensates intended for use in hot-smoked sausages.
- Model systems, such as suspensions of smoke condensates in refined lard may give misleading concepts of the flavouring properties of smoke condensates.

References

1. Bratzler, L.J., Spooner, M.E., Weatherspoon, J.B. and Maxey, J.A.: Smoke flavor as related to phenol, carbonyl and acid content of Bologna. J. Food Sci. 34, 146, 1969.
2. Fiddler, W., Doerr, R.C. and Wasserman, A.E. Composition of an ether-soluble fraction of a liquid smoke solution. J. Agr. Food Chem. 18, 310, 1970.
3. Fiddler, W., Wasserman, A.E. and Doerr, R.C.: A "smoke" flavor fraction of a liquid smoke solution. J. Agr. Food Chem. 18, 934, 1970.
4. Gorbatov, V.M., Krylova, N.N., Volovinskaya, V.P., Lyaskovskaya, Yu.N., Bazarova, K.I., Khlamova, R.I. and Yakovleva, G. Ya: Liquid smokes for use in cured meats. Food techn. 25, 71, 1971.
5. Hruza, D.E., van Praag, M. and Heinsohn, H. Isolation and identification of the components of the tar of hickory wood smoke. J. Agr. Food Chem. 22, 123, 1974.
6. Langner, H.J. Aromabestandteile von Flüssigrauch und Rauchsalzen zur Sekundärräucherung von Lebensmittel. Die Fleischw. 46, 961, 1966.
7. Potthast, K. Zur Zusammensetzung von Räuchermitteln. Die Fleischw. 54, 183, 1974.