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U S S R

V.M.Gorbatov, V.I.Kurco

EXPRESS METHOD FOR DETERMINATION OF THE
RATE OF PENETRATION OF SMOKE COMPONENTS
INTO PRODUCT AND THE USE OF THIS METHOD
FOR STUDYING THE PROCESS OF SMOKING

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S U M M A R Y

A simple method for a prompt determination of the degree of smoking of sausages was developed. The method is based upon the reaction of interaction of smoke phenols which penetrated into the smoked product, with 2,6-dichlorochinonchlorimide. The paper containing this reagent is pressed against a section of the smoked product under study. The depth of phenol penetration into the core of product is judged upon limits of blue discolouration on the imprint.

The method was used for studying influence of some factors on the degree of penetration of smoke phenols into the product. These factors were as follows: preliminary ageing of sausages, type of casing, recipe, smoking in high tension electrostatic field.

The method may be used also for studying other various problems of smoking, as well as for controlling the degree of smoking of products in the process of their preparation.

EXPRESSMETHODE ZUR FESTSTELLUNG DER EINDRINGUNGS-
GESCHWINDIGKEIT DER RÄUCHERKOMPONENTE IN DIE
WARE UND DEREN VERWENDUNG ZUR UNTERSU-
CHUNG DES RÄUCHERVORGANGES

W.M.Gorbatow,
W.I.Kurko

Z U S A M M E N F A S S U N G

Eine einfache Methode für schnelle Feststellung des Räucherungsgrades der Würste, deren zu Grunde eine Reaktion zwischen den in die Räucherware eingedrungenen Phenolen und 2,6 Dichlorchinonchlorimid liegt, wurde ausgearbeitet. Das mit diesem Reagens imprägnierte Papier wird an den Schnitt gedrückt und die dabei entstehende blaue Farbe den Eindringungsgrad der Phenole in die Ware wiedergibt.

Die Methode ist zur Untersuchung des Einflusses einiger Faktoren auf das Eindringungsgrad der Phenole in die Ware geeignet; hierzu gehören: vorläufige Lagerung der Würste, Art der Hülle, Beschaffenheit der Wurstmasse und Einfluss der Räucherung im elektrischen Hochspannungsfeld.

Diese Methode kann man auch zur Erforschung anderer Probleme und zur Kontrolle des Räucherungsgrades während der Wurstherstellung benutzen.

INSTITUT DE RECHERCHES SCIENTIFIQUES DE L'INDUSTRIE
DE VIANDE
DE L'URSS

UNE METHODE RAPIDE DE L'INVESTIGATION DE LA PENETRATION
DES ELEMENTS DE LA FUMEE DANS LES PRODUITS A FUMER
ET L'EMPLOI DE CETTE METHODE A LA RECHERCHE
DU PROGRES DU FUMAGE

V.M.Gorbatov,
V.I.Kourko.

S O M M A I R E

Une simple méthode pour une rapide investigation du degré de fumage des saucissons basée sur la réaction des phénols de la fumée pénétrée à l'intérieur des saucissons avec la 2,6 dichlorochinonchlorimid a été mise au point. Le papier imprégné de réactif en question est appliqué à l'endroit de la séquence du produit à fumer et d'après l'importance de l'empreinte on juge de la profondeur de pénétration des phénols à l'intérieur du produit.

La méthode est employée pour déterminer l'influence de la composition de la farce, du fumage dans le champ électrique de haute tension.

La méthode peut être utilisée aussi pour l'investigation d'autres problèmes du fumage et pour le contrôle du degré de fumage des produits tout au cours de leur préparation.

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EXPRESS METHOD FOR DETERMINATION OF THE RATE OF
PENETRATION OF SMOKE COMPONENTS INTO PRODUCT AND
THE USE OF THIS METHOD FOR STUDYING THE PROCESS
OF SMOKING

V. Gorbатов,
V. Kurco.

Both in the production of sausages and in studying the process of smoking a necessity often arises to promptly determine the rate of penetration of smoke components into the product.

For instance, it is important to know this factor for comparing smoking degrees of sausages in new types of artificial casings and sausages in natural casing, while studying the distribution of flows of smoking medium in smoking cabinets, or effect of different technological ways of preparing sausage meat on subsequent treatment by smoke.

The rapid method for determination of the depth of penetration of smoke components into the product may also be used for a most quick control of the smoking process and an objective determination of its end point.

The existing chemical methods of analysis require much time. Furthermore the depth of penetration of different smoke components may be estimated by means of data of these analyses only with a significant approximation. It was proposed, therefore, to use qualitative reactions on certain groups of organic substances of smoke for a rapid determination of the depth of penetration of smoking components into the product.

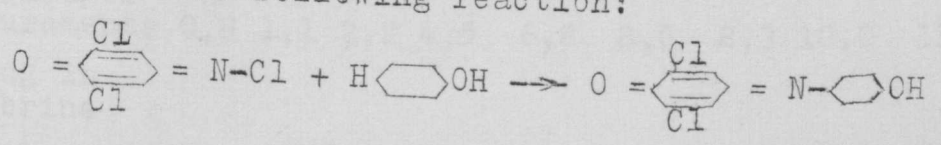
Technique of the express method

The most convenient way for producing colour reactions with groups of smoke components of the same type, which penetrated into the smoked product, is as follows: preliminarily treated paper (chromatographic as the most convenient) must be pressed against a fresh section of a sausage. The chemical compounds from the surface of the section react with the reagents on the paper, thus forming a discolouration of any kind.

This method was used for finding reactions of acids, aldehydes, phenols etc. with a number of reagents (bromthymol blue, 2,4-dinitrophenylhydrazine, sodium nitroprusside, hydrochloric hydrazine, phloroglucine, diazotized sulfacid, 2,6-dichlorochinonchlorimide and same others).

The reaction of detecting phenols (one of the most characteristic groups of smoke compounds) by means of 2,6-dichlorochinonchlorimide proved to be the most hopeful one.

The interaction of phenols with 2,6-dichlorochinonchlorimide takes place in an alkali medium (to this end the paper is impregnated with borax solution) according to the following reaction:



Resulting compounds have bluish-dark blue colour, which stands out sufficiently clear against a brownish background of the imprint. A coloured imprint is produced quite rapidly. Complete detection lasts about 3-4 minutes, the fact which allows us to consider the method as an express one.

The succession of the analysis is as follows: a thin slice is cut from a smoked sausage. Then paper (preliminarily impregnated with solution of sodium

borate) slightly moistened with alcohol solution of a developer (1 g of 2,6-dichlorochinonchlorimide in 60 ml of C_2H_5OH) is put on both sides of the slice. The treated paper is covered by a sheet of simple paper and flat pieces of expanded rubber or a soft plastic. By means of a simple device (Fig.1) the treated paper is uniformly pressed against the section of the sausage. Then the imprints are hanged in the air for a short time until blue discolouration develops. The limits of this discolouration indicate the depth of penetration of phenols into the core of the product.

The use of the express method for studying the process of smoking

The effect of preliminary ageing of sausages

Table 1 and Figures 3 and 4 show that smoke phenols penetrate into the core of sausage slow but uninterruptedly. Hence the process is a diffusion one.

Table 1

Experiment	Depth of penetration of phenols (mm)								
	1h.	2h.	3h.	18h.	66h.	90h.	114h.	138h.	168h.
Ageing in the air									
1 series of measurements	0,8	1,3	1,8	4,5	6,7	7,6	8,7	9,9	10,1
2 series of measurements	0,9	1,1	2,2	4,5	6,8	8,0	8,3	10,0	11,1
Ageing in the brine									
1 series of measurements	1,5	1,7	2,0	-	7,2	8,5	8,9	11,0	12,0
2 series of measurements	1,4	1,6	2,1	-	7,7	8,8	8,6	10,8	12,1

Table 2.

Temperature of ageing C°	Depth of penetration (mm)								
	1h.	3h.	5h.	17h.	20h.	27h.	39h.	61h.	85h.
3	0,8	1,0	1,2	3,0	4,0	5,5	7,0	10,5	19,0
20	0,7	1,0	1,3	4,2	5,5	6,0	7,0	11,0	18,1

Table 3 shows that with the cold smoking by sparse smoke the depth of penetration of phenols into sausage is, practically, directly proportional to the duration of smoking. But with the smoking by dense smoke (Fig.4) no directly proportional dependence is seen at first glance (the first section of the curve sharply varies from its rest).

In fact, the cited assumption does not lose its vigor, since the character of the curve on Fig.4 can be easily explained on the basis of diffusional phenomena. With the smoking by dense smoke deposition of smoke components on the sausage surface and consequently their penetration into upper layers of the product goes on rather intensively, that is to say that with the smoking in a medium highly saturated with smoking components, their rate of penetration into upper layers of the product is higher than the rate of their diffusion in the product itself. A certain equilibrium is established comparatively soon and subsequent penetration of smoke particles into the product is directly proportional to the duration of smoking (it is this dependence that commands the main and largest section of the curve on Fig.4).

Penetration of smoke phenols into the product as effected by the type of casing and composition of minced meat

Different casings were filled with minced cured pork (half-fat and lean), minced beef (without visible fat), minced meat for Rostovskaya sausage and diced

back fat (2x2 mm).

All sausages were kept for some hours for setting. Then they were smoked for 96 hours in a usual industrial smoking chamber of sausage plant. The chamber was designed for cold smoking at 22-24°C by sparse smoke produced from wood of different leaf species. Every other day samples of sausages were taken, in which the depth of penetration of phenols was determined by the above described method.

Table 3 shows the results of the measurements (average data from four for every measurement).

Table 3.

Minced meat	Depth of penetration of phenols (mm)			
	24 hours	48 hours	72 hours	96 hours
Minced meat for dry sausage in				
cutisin casing	1,5	2,0	3,8	4,6
natural casing	2,0	3,2	4,8	6,5
Minced lean pork in				
cutisin casing	1,7	2,1	4,3	6,2
natural casing	2,0	3,0	5,6	7,0
Minced half-fat pork in				
cutisin casing	2,0	2,8	5,0	6,2
natural casing	3,0	3,3	7,0	7,4
Minced beef (1 grade) in				
cutisin casing	0,8	1,6	3,9	4,6
natural casing	1,0	2,3	4,8	6,0
Diced back fat in				
cutisin casing	3,5	4,8	7,2	-
natural casing	3,9	6,0	9,0	-

The following conclusions can be drawn from the data in Table 3:

1. The degree of penetration of phenols is less when minced meat was stuffed in cutisin casing and higher when it was stuffed in natural casing.

This dependence is found in all the five variants of the experiment (Fig.5).

The results obtained are similar to those of Czech investigators.

2. The rate of penetration of smoke phenols into sausages with casings of the same type depends on their content. The highest rate of penetration of phenols was observed when casings were stuffed with diced back fat, then with half-fat minced pork, lean minced pork, minced meat for dry Rostovskaya sausage, and, finally, with minced beef (1st grade). This phenomenon is based upon the content of fat, more precisely-fat tissue, in the studied objects rather than upon the content of salt. If we exclude from comparison the experiment with Rostovskaya sausage, we shall see that the rest of samples obey the following dependence: the higher fat tissue content of minced meat, the quicker phenols penetrate into sausage, and viceversa.

Penetration of smoke components when smoking
in high tension electric field

An insufficient study of chemical and physico-chemical aspects of electric smoking impairs correctness of some explanations of the essence of this process.

It is stated, for example, that "... owing to a high velocity particles (of smoke) penetrate deep into the product ... resulting in better and quicker smoking than with the traditional method". Or "... under the effect of electricity smoke settles on fish and simultaneously penetrates into it".

Some authors, speaking about forced diffusion of smoke into the product in the process of electric smoking, share similar views, while others consider, that penetration of smoke particles is trifling, if any.

Fig.6 shows data about penetration of phenol substances of smoke into sausage. The data were obtained by the method of imprints. As can be seen from Fig.7, diffusion of smoking components, going on rather slow, has, during first 48-72 hours, the character of linear dependence. Then penetration into inner layers of the product is somewhat slackened, what is due to increased firmness of meat, decreased content of moisture in the product and some other factors. No penetration of smoke phenols under casing was found either immediately after processing of samples in the electric installation, or during first 2 or 3 hours after that. This circumstance refutes the above cited assertion about forced diffusion of smoke components into the product during electric smoking.

Use of the express method for technical and chemical control of smoking sausages

The depth of penetration of smoking components into the core of sausages depends on duration and intensity of their processing by smoke, composition and state of minced meat and some other factors. From Fig.8 one can see the difference between degrees of penetration of smoke phenols into cooked smoked, summer and dry sausages immediately after extraction from smoking and roasting chambers. Thus, having determined the limits of penetration of smoke phenols into sausages, which are being smoked, one can control sufficiency of the process by comparing the real degree of penetration of phenols with a required one on obtained imprints.

It is necessary to point out one more peculiarity of this method. When contacting the surface of a sausage section, imprints of phenols, which penetrated into pieces of back fat, appear on the treated paper, while portions of paper contacting pieces of muscular tissue contain no phenols. Therefore the best results (the clearest limits of penetration of phenols) are obtained with sausages with a uniform distribution of back fat in minced meat (frankfurters, small sausages, dry sausage with cuttered back fat). The reason for different interaction of phenols, which penetrated muscular and fatty tissue, with treated paper is not clear as yet.

Conclusion

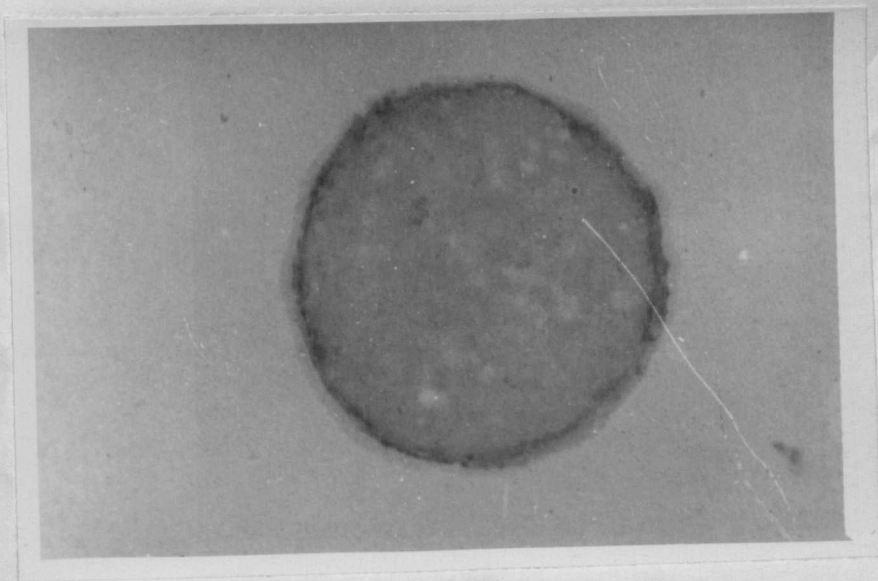
A simple method for a quick determination of degree of smoke components (phenols) penetration into the core of smoked products was developed.

The express method can be used both for studying process of smoking, and controlling it when producing smoked products.

Literature

1. Blashek R., Schufler M., Lebensmit. Ind., 1958, II, 489.
2. Debrowolzki T., Husipar, 1958, 7, 1-2, 23.

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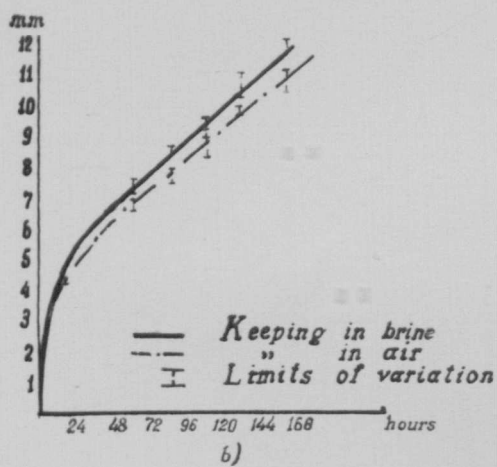
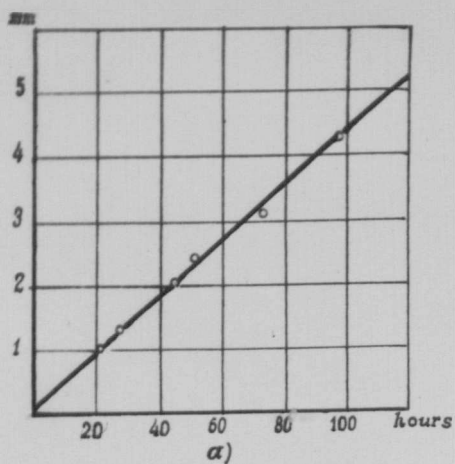


Fig. 3.4 - The depth of penetration of smoke phenols into sausages during cold smoking: a) - by sparse smoke; b) - by dense smoke.

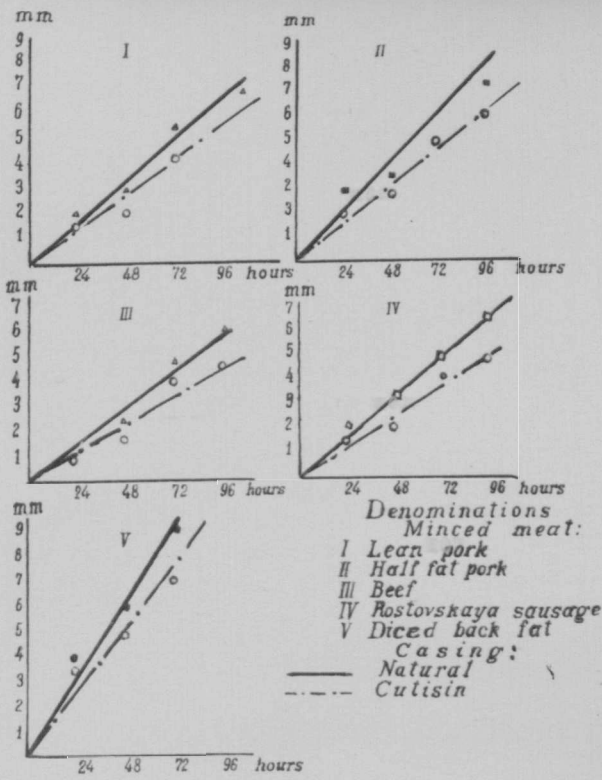
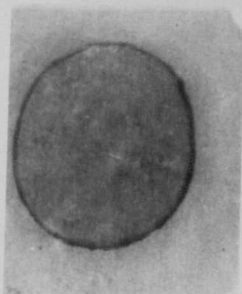
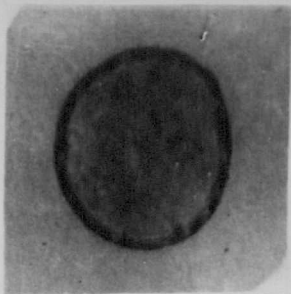


Fig. 5. The rate of penetration of smoke phenols through cutisin and natural casings during cold smoking

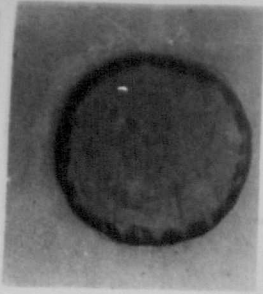
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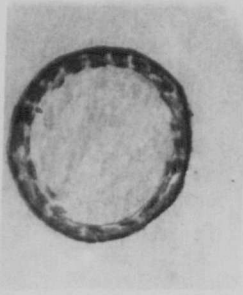
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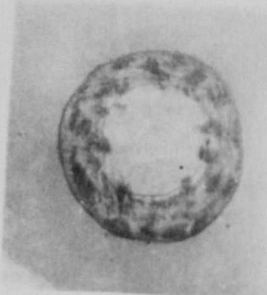
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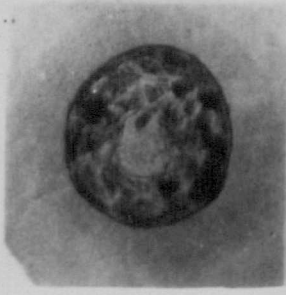
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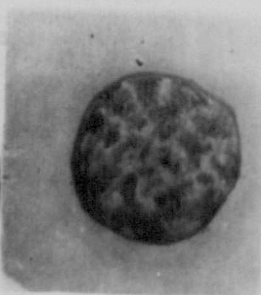
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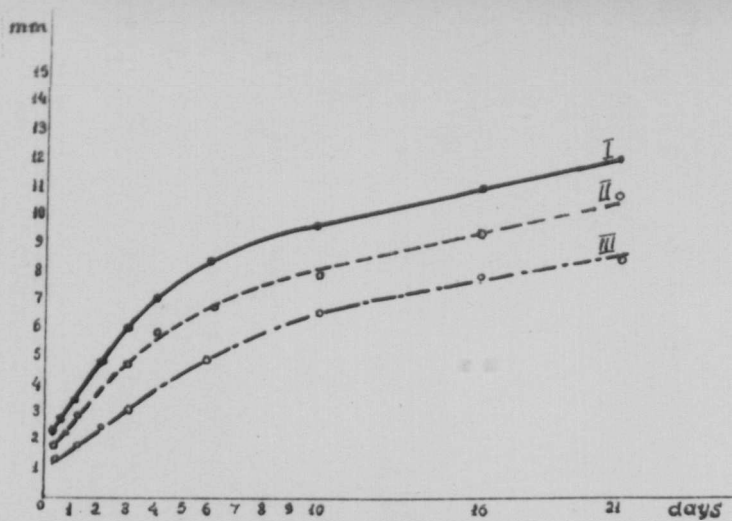


Fig 7

The penetration of phenols during the storage of sausages smoked in the electric field by beech smoke:
1-natural casing, sawdust burnt by means of electric heating;
2-natural casing, smoke produced by friction smokegenerator;
3-culisin casing, sawdust burnt by means of electric heating

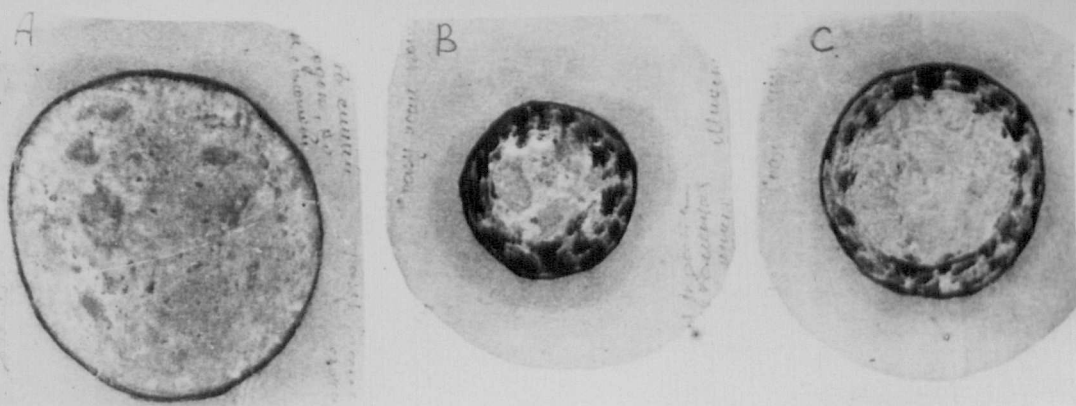


Fig.8. Comparative depth of penetration of smoke phenols into sausages measured just after removing them from the smoking chamber: a - cooked smoked, b - summer, c - dry.