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COMPARISON OF THE CONTENT OF SMOKE COMPONENT IN MEAT PRODUCT SMOKED TRADITIONALLY AND TREATED WITH LIQUID SMOKE

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INTRODUCTION

Consumption of smoked meat products in Poland is among the highest in the world. While precise data is lacking we estimate that the consumption level exceeds 20kg/person/year. It is known that during the smoking process, a very complex mixture of chemical compounds penetrates a food product. A significant percentage of this mixture is constituted by phenolic compounds. The phenolic compounds play a meaningful role in specific organoleptic properties of smoked products; they also act as preservatives. This role of the phenolic compounds is relatively well known. However, as it was revealed by Knowles *et al.* (1975); Jordan and Tooth (1985) and Hofmann (1990), phenolic compounds may react with residual nitrite, producing nitrosophenols and nitrophenols in meat products. Besides, many phenolic compounds (e.g., phenol, cresols and other alkyl-derivatives of phenol) are notorious for their toxicity, rendering their presence in food to be undesirable. Literature data on the phenolic compound content of smoked meat products indicates that these compounds may be present there in highly variable concentrations. For example, Potthast (1977) found more than 160ppm of these compounds in hot-smoked Kassler type products and higher than 200ppm in "black smoked ham". Similarly, Bratzler *et al.* (1969) discovered 122ppm of phenolic compounds in bologna sausage, applying a non-selective method. Knowles *et al.* (1975) found a 100ppm phenolic compound concentration in smoked bacon, using their own method. Significantly lower quantities of phenolic compounds were detected by Baltes and Sochtig (1979) in cold-smoked sausages (3.1ppm) and in the core of cooked sausage (7.2ppm).

As we mentioned before, precise data on phenolic compound levels in Polish meat products are not available. Consequently, we decided to investigate the problem in detail. The aim of the present work was to determine and compare the content of the phenolic compounds in meat products such as frankfurters, bacon and cooked ham that are either traditionally smoked or treated with a liquid smoke called Refined Smoke Flavour (RSF, Polish patent no 136687).

MATERIALS AND METHODS

Three product types were taken from large meat plants in various regions of Poland. In total, 18 samples were examined (three samples taken from each product): frankfurters, smoked bacon and cooked ham, treated traditionally and with RSF. The traditionally treated products were smoked in commercial chambers (type Atmos 2000) or similar, with smoke generated by smouldering smoke generators. The process of smoking was continued until the desired colour intensity was obtained. Products treated with RSF were also smoked in Atmos 2000 type chambers or similar. A pneumatic atomizer (type TAM) was used to spray RSF (50 cm^3 for each m^3 of chamber capacity). Afterwards, the product was heated at 70°C for 15 minutes to stabilize colour. Samples, containing no less than 2kg meat, were ground three times and then two batches of 100g each were taken for parallel determination of the phenolic compounds. The phenolic compounds were isolated by steam distillation under a lowered pressure of approximately 100kPa, in the presence of lithium chloride and hydrochloric acid. Typically, a 100g sample of meat product was homogenized for five minutes with 30cm^3 of distilled water, 40g of lithium chloride p.a. and 5cm^3 of hydrochloric acid p.a. The homogenate was quantitatively transferred to a round-bottom 500cm^3 flask with 30cm^3 of distilled water. The distillation was performed in a typical glass set, consisting of a distillation flask, catch-drop (entrainment separator), condenser, Perkin distillation head, receiver, manostat, and oil vacuum pump. During the initial phase, the homogenous sample was

carefully degassed without heating. Then, the sample was heated in such a way that the distillation was running uniformly with the pressure being 100kPa. The distillation was accomplished with a temperature of about 105°C in the distillation flask. The degassing and distillation time was about one hour. Purification and concentration of the isolated phenolic compounds was performed on an Amberlite XAD-4 column. The distillate, phenolic compounds was filtered through Amberlite XAD-4 (60-80 mesh; 20:1cm), washed with 30cm^3 of distilled water and 30cm^3 of cyclohexane p.a. Phenolic compounds were eluted from the column using 15cm^3 of ethyl ether. The ether solution was dried over potassium sulphate and then concentrated to 0.6cm^3 in Cuderna Denis apparatus in water bath at 60°C. A GLC determination of the isolated phenolic compounds was performed using a Hewlett Packard gas chromatograph (Model 5890, series II) on capillary cross-linked column, 50m long, ID: 0.2μm x 0.33μm, splitless injector; programmed column temperature: 40-200°C, temperature increment 4°C/min.; carrier gas: helium-30kPa; flame ionization detector (FID). Comparison of peak areas of the compound of interest with those of a standard mixture permitted a quantitative evaluation. The GLC-MS method was applied for the identification of the determined components using a mass spectrometer (Model 5989A Hewlett-Packard). Conditions of the separation were identical with those previously applied for the determination of the phenolic compounds. The sample (1μl) was injected on the column with a split ratio 1:50. The injection temperature was 250°C, ion source: 250°C, ion energy 70 eV, scanning range: 35-650amu, and threshold = 200. A complete description of the method was given by Borys (1993).

RESULTS AND DISCUSSION

The phenol content in samples of traditionally smoked frankfurters, bacon and ham, as well as in those prepared with the use of RSF are given in Table 1. The following compounds were determined: cyclotene (CY), guaiacol (GU), phenol (PH), 4-methylguaiacol (4-MG), m- and p-cresol (CR), 4-ethylguaiacol (4-EG), syringol (SY), eugenol (EU), 4-methylsyringol (4-MS), 4-ethylsyringol (4-ES), and catechol (CA).

The table also gives the total content of the determined compounds and mean values of the determined compounds in each product type. As can be seen from the results in Table 1, the method used for the determination of phenolic compounds (Borys, 1993) gave a mean phenolic compound recovery of 63.3%; the recovery decreased gradually with the increase of atomic weight of the determined compound. For example, a mean value of phenol recovery was 93.4%; of m- and p-cresol - 79.6%; of 4-methylguaiacol - 72%; of 4-ethylguaiacol - 61.2%; of syringol - 58.6%; of 4-methylsyringol - 28.4% and of 4-ethylsyringol was 18.8%.

Introduction of correction coefficients for particular compounds in the examined samples increased their level from 57%in ham smoked with RSF (global content increased from 40.4ppm to 63.5ppm) to 74% for traditionally smoked bacon (from 36.4ppm to 63.2ppm). Due to the increasing error of determination, only the results without correction were further analyzed. Analysis of the results revealed a high variability in the levels of the phenolic compounds that penetrated the differently smoked products. Such considerable differences in the content of the phenolic compounds in the studied products is evidence that many factors occurring during the traditional smoking process or RSF application have a significant influence on the process of phenolic compound penetration. The mean values indicate that frankfurters and bacon treated with RSF contained considerably lower levels of the phenols (by 30% and 36%, respectively) than the same products traditionally smoked. On the other hand, the reverse tendency was observed for ham, where in the case of RSF treatment, the level of phenols was higher by 26% in comparison to ham cured by the traditional method. No significant differences between the individually determined compounds were found, and their values usually increased with the increase of the total content of the phenols. The only exception was catechol which was determined only in certain traditionally smoked samples.

CONCLUSIONS

On the basis of the 18 samples examined, the level of phenolic compounds was determined in frankfurters, cured bacon and cooked ham. A considerable variation in the levels of phenolic compounds was discovered; their level varied from 17.7ppm to 76.2ppm.

Application of a liquid smoke (RSF) instead of the traditional smoke-curing decreased the content of phenols in products by 36% for cured bacon and by 36% for frankfurters. For ham, an increase in the phenols content by 26% was observed in the case of RSF use. The fundamental observation is that for all the examined products, 20ppm of the determined phenolic compounds was sufficient for the retention of the desirable organoleptic properties that are typical for smoked product. In the author's opinion, a continuation of these studies to obtain data concerning the level of phenols in other smoked Polish products and to determine the influence of technological parameters on these levels,would serve a useful purpose.

REFERENCES

BALTES, W., and SOCHTIG, I. 1979. Determination of a smoke flavour condensate admixture to sausages by gas chromatography on glass capillary columns. *Zeitschrift fur Lebensmittel Untersuchung und Forschung.* 169:17-21.

BORYS, A. 1992. Method for determination of phenolic component in smoke in meat product. *Roczniki IPMiT.*(in press).

BRATZLER, L.J., SPOONER, E., WEATHERSPOON, J.B., and MAXEY, J.A. 1969. Smoke flavour as related to

phenol, carbonyl and acid content of bologna. *J. Food Sci.* 34:146-148.

HOFMANN, G. 1990. Studies on occurrences of nitrosophenols in cured and smoked meat products. *Fleischwirtschaft.* 70(10):1144-1148.

JORDAN, S., and TOTH, L. 1985. Reaction of nitrite with phenols present in smoke used for smoking meat product. Mitteilungsblatt der Bundesanstalt fur Fleischforschung. Kulmbach. 88. 6470-6475.

KNOWLES, M.E., GILBERT, J., and McWEENY, D.J. 1975. Phenols in smoked, cured meats: nitrosation of phenols in liquid smokes and in smoked bacon. *J. Sci. Food Agri.* 26:267-276.

POTTHAST, K. 1977. Determination of phenols in smoked meat products. *Acta Alimentaria Polonica.* 3(3):189-193.