

SESSION 7. FERMENTED MEAT PRODUCTS

7:1

DRY CURED HAMS PRODUCED FROM FROZEN/THAWED RAW MATERIALS

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Previous dry curing model experiments with pork revealed an accelerated salt uptake when the meat had been frozen/thawed prior to curing (Sørheim and Gumpen, 1986). In the present work the use of frozen/thawed raw materials in the production of dry cured hams was studied with regard to processing time and product quality.

Four fresh and 4 frozen/thawed hams of approximately 8.5 kg. were processed equally for 106 days. The process consisted of 17 days of dry curing, 28 days of brine (20° Bé) curing, 14 days of maturation, 2 days of freshening and finally 45 days of drying (18°C/75 % relative humidity). Weight registrations and salt analyses were performed at different stages of the process. Salt distribution was examined by non-destructive computed X-ray tomography (CT). Sensory quality of the hams was evaluated by a trained laboratory panel and colour was measured on a Hunterlab LabScan II spectrophotometer.

Freezing/thawing accelerated the salt uptake and increased the weight loss of the hams at the dry curing period. These effects may shorten the total curing time by approximately one week. When the hams were compared after equal total processing times, the "frozen/thawed" hams had higher weight loss, higher salt content, lower sensory quality and darker colour than the "fresh" hams.

7:2

STUDIES ON THE ACTIVITY OF Micrococci IN VIEW OF THE SELECTION OF STARTER CULTURES. I. CATALASE ACTIVITY OF STRAINS ISOLATED FROM RAW-DRIED MEAT PRODUCTS

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A characteristic property of micrococci is the synthesis of catalase necessary for the neutralization of peroxides which, in meat and meat products, bring about defects in the colouring, and also rancidity in fats.

The objective of the present work was to study the catalase activity of some micrococcus strains isolated from typical national raw-dried meat products manufactured in different regions of the country.

Volumetric and specific activities were determined, expressed in terms of U/ml of sample or mg of protein, by the spectrophotometric method of Bergmeyer. Also the numbers of cells per ml of sample were estimated.

The effects of the nutrient media on the growth and the enzymatic activity of the investigated strains were studied. The different variants of nutritional media for micrococci differed by the introduction of ascorbic acid, different types of yeast extract, dry milk, sodium chloride, sodium citrate, different types and quantities of carbohydrates. It was found that the requirements of the individual strains towards the composition of the nutritional medium were different.

In all cases, ascorbic acid and sodium citrate stimulated growth and affected catalase activity. In some strains, the addition of dry milk had a positive effect on the numbers and the activity of micrococci. The greatest number of cells was obtained upon the introduction of sucrose into the nutritional medium as a carbohydrate source.

In the present study, no correlation was found between the counts of microorganisms in the nutritional medium and the enzymatic activity produced. Further, a study was made of the effect of broth culture age (24, 48, or 72 hours) on the growth and the enzymatic activity of the micrococci investigated. Differences in the enzymatic activities of the individual strains were found (from 0.61 to 1.73 U/mg of protein) on the 24th hour of the cultivation of the broth cultures. In general, a tendency could be observed towards the enhancement or preservation of catalase activity till the 72nd hour of the growth of the microorganisms, the activity decreasing subsequently. Using an optimum nutritional medium for cultivation, the effects were determined of pH values (5.0, 5.5, 6.0, or 6.8) and temperatures (20°, 25°, or 30°C).

In the pH range shown, the investigated strains demonstrated an increase in catalase activity at a pH value of 5.5 compared to 5.0, which was preserved the same up to pH 6.8. The growth temperature of the strains in a nutritional medium had an effect on enzymatic activity. The temperature of 25°C was found to be more appropriate than either 20 or 30°C.

7:3

STUDIES ON THE ACTIVITY OF Micrococci IN VIEW OF THE SELECTION OF STARTER CULTURES. II. NITRATE REDUCTASE ACTIVITY OF Micrococcus varians STRAINS M₆, M₁₁₅, M₈₃

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The effects were studied of various factors: different variants of nutritional media, pH values (5,0, 5,5, 6,0, 6,8), nutritional media temperatures (20°, 25°, or 30°C), and broth culture ages, 24 h, 48 h, or 72 h, on characterizing the nitrate reductase activity of Micrococcus strains in view of their application as starter cultures.

Also, nitrate reductase activity was studied depending on different conditions of incubation: several concentrations of substrate (40 mg%, 80 mg%, or 160 mg%), pH values (5,5, 6,0, or 6,5), and temperatures (25°, 37°, or 44°C) of the incubation solutions, in order to determine the optimum conditions of the enzymatic reaction.

The microorganisms under investigation belong to the species of Micrococcus varians, strains M₆, M₁₁₅, M₈₃, isolated from raw-dried meat products. Nitrate reductase activity was determined by Egami and Taniguchi's (1970) method modified by Puolanne (1977) and was expressed in μ mol of nitrite related to the number of micrococci per ml of sample.

The development and reproduction of microbial cultures depend on the contents of nutrients

in the cultivation medium. They also affect enzymatic activity.

The optimum pH value of the cultivation medium was found to be 6,8, and the optimum temperature, 25°C for all the three strains under investigation.

With the ageing of the cultures, up to 72 h, a trend was observed towards retaining or enhancing nitrate reductase activity.

The pH optimum of the incubation solution for all the three strains investigated was estimated at 6,0, no significant decrease in nitrate reduction being found at pH 5,5 to 6,5. Depending on incubation temperature, a weak deviation of the enzymatic reaction was found.

The reduction of nitrates with the three substrate concentrations investigated was nearly the same.

7:4

INVESTIGATION ON OXIDATIVE CHANGES IN LONG RIPENED DRY SAUSAGE

Mrs. Anna Nagy, Mrs. Vilma Mihályi and Incze, K. Hungarian Meat Research Institute, 1453 Budapest, P.O.B.17.

Questions of rancidity-development during ripening and storing of dry sausage is not completely understood. It has already been shown that acid-number of such ripened products is usually high, which sometimes is considered as quality defect. It is believed namely that increase of acid number is a sign of formation of acidic compounds as a consequence of oxidative(rancidity) changes. Szeredy made a comparison between peroxide and acid numbers of lard and fat rendered from dry sausage and stated that while acid number in lard shows only a minor change during storage and rancidity can already be detected at a value of 2, a five fold increase in acid number takes place during the same period in dry sausage without showing any sign of rancidity.

In our experiments we wanted to follow the changes in acid number during ripening and different ways of storage with special regard to the relationship between acid number and other parameters referring to rancidity. Changes in color of dry sausage during ripening have also been examined. Samples were taken at 0 time and at intervals of 10, 40, 70 and 100 days after production during ripening, as well as monthly during storage. Samples were stored at ambient temperature /+18-22°C/ and 65-70 % rel. humidity, partly hung, partly in cardboard boxes with openings on the wall.

Moisture content, pH value, total pigment %, number of lipolytic micro-organisms, peroxide number, TBA-number, benzidine number, acid number have been measured, organoleptic evaluation has been carried out.

It can be concluded that pH decreases at the first stage. Since the product is ripened the traditional way at low temperature and the formula contains no added carbohydrate, pH decrease may be explained by acetic acid deposited on the surface during intensive smoking. Later during ripening however a definite pH-increase takes place. Peroxide-, benzidin- and TBA-numbers increase during ripening and storage, although initial values of those decrease temporarily during and after smoking. For the increase of acid number during ripening and storage bacterial activity is likely to be responsible in form of raising the amount of free fatty acids while autoxidative changes of fat do not play a role in this respect. Significant difference has been found between the two ways of storage mainly in terms of color stability of dry sausage.

7:5

EFFECT OF A COMMERCIAL STARTER CULTURE ON SURVIVAL OF SALMONELLAE IN METTWURST

R. AVNAT and R. SPANGENTAL

Maadaney Mizra, Sausage and Meat Products, Kibbutz Mizra 19312, Israel

Salmonella is one of the most important meat poisoning bacteria, due to its high pathogenesis, especially in the very young, old or debilitated humans (ICMSF, 1978). Due to their high sensitivity to heat, acidity and low water activity, these organisms are rarely found in either cooked or long fermented meat products. However, they may be a problem in fresh uncooked products, such as Mettwurst. The aim of this work was to find a correlation between the number of inoculated *Lactobacilli* and the number of surviving *Salmonellae* in *Salmonella*-inoculated Mettwurst.

26 Mettwurst sausages weighing ca. 150 grams each were inoculated with a commercial starter culture (Combi Start 1505, Christian Hansen's Laboratories) and a group D *Salmonella* sp. according to the following 2x(4x3+1) design: Starter culture was standardized to give 4 inoculation levels of *L. plantarum* (10^5 , 10^6 , 10^7 and 10^8 cells per gram of sausage) and the *Salmonella* sp. was standardized to give 3 inoculation levels (10, 100 and 1000 cells per gram sausage). A thirteenth combination was inoculated with 10^7 *Lactobacilli* per gram and no *Salmonella* and served as a control. Each of these combinations consisted of 2 sausages; of which one was tested right after processing while the other was kept at 4 deg. C. for seven days after processing and then tested.

Results showed that inoculation of Mettwurst with 10^8 *Lactobacilli* of this culture per gram sausage followed by a 4-day-fermentation and a 7-day-refrigeration periods reduced *Salmonella* level inoculated at 1000 cells/g to about 1 cell/g sausage.

7:6

POSSIBILITIES OF PRODUCTION AND SOME QUALITY CHARACTERISTICS OF DRY POULTRY MEAT SAUSAGES

Lj. Nedeljković, Zorka Veljić, Gordana Vojinović, M. Isakov; *Ružica Diklić

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By analysis of the products on Yugoslav market, it is found out that dry poultry meat sausages are not present. In this article, the authors investigated possibilities and some quality characteristics of dry poultry meat sausages with fat tissue from poultry and pigs in domestic conditions.

For the experimental production of dry poultry sausages was used frozen broiler breast and thigh meat, pig's and poultry's fat tissue, salt, sugar, sodiumnitrite and spices. The mixture was prepared by usually manner in cutter, and than stuffed into pig's thiny intestines which were paired on 12 cm length. Smoking and drying is done in domestic climate-rooms.

During the riping time, loses of weight, chemical composition, pH, a_w value, microflora were assesed. At the end^w of the riping time, sausages were estimated organoleptically by the group of experts.

Weight loses were from 32,94% (the sausages from thigh meat and poultry fat), till 36,76% (the sausages from breast meat and poultry fat).

By chemical investigation it is determined that percent protein ranged from 19,23% in

the sausages from thigh meat and poultry fat to 22,23% in the sausages from breast meat and pig's fat.

Moisture was from 15,69% in the sausages from thigh meat and pig's fat, till 25,38% in the sausages from thigh meat and poultry fat. Amount of fat was from 50,47% in the sausages from thigh meat and poultry fat till 55,71% in the sausages from breast meat and pig's fat.

pH value was from 6,40 in row thigh meat, respectively 5,85 in row breast meat, till 5,36 in the sausages from thigh meat and pig's fat, respectively 5,45 in the sausages from breast meat and pig's fat. a_w value was typical for dry sausages. By bacteriological investigation, microflora was assesed and it was concluded that the riping process was regular so that the only microflora was *Lactobacillus* at the end of the riping process. Organoleptical estimation enclosed the further characteristics: colour, appearance and dressing of mixture, consistence and flavour. It can be concluded that these sausages were products with special characteristics, especially the sausages from breast meat and poultry's fat.

Based on these investigations and reached results, it can be concluded that there are the real possibilities for production of dry poultry sausages in domestic conditions using corresponding technological procedure.

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7:7

CHEMICAL CHARACTERISTICS OF "SALPICÃO" A TRADITIONAL PORTUGUESE SMOKED SAUSAGE

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Portugal has a large variety of traditional sausage products. Among the various kinds of the smoked sausage named "salpicão", available in northern Portugal, there is the Vila Real type, which is the object of this study. "Salpicão" is a kind of large sausage (± 50 mm of diameter) cured with smoke, varying in composition, spices and technological process according to the region.

The objective of this work was to study a traditional type of smoked sausage produced by an intensive technological process, particularly in the maturation and ripening periods, in order to obtain a stable pattern.

The following variables were studied: pH; water activity (aw); moisture, protein; fat; ash; and salt (NaCl).

The Vila Real type consists of a single piece of meat (pork loin or ham), weighting 200-300gr, matured for four days at 5°C with salt (4.5%), garlic (0.2%) and red wine (7.5%). The stuffing is filled into gross pork gut, subject to the drying effect of smoke for three days in a traditional smokery, and kept at environmental temperature for four days.

The samples studied were vacuum packaged to prevent variations, especially in terms of moisture.

An Orion pH meter was used for the pH determinations; aw was determined by exposing the samples to an environment with relative humidity controlled by saturated salt solution at 25°C (Serrano Moreno, 1979); moisture, fat, protein, ash and salt content were determined according to the A.O.A.C. procedures (1975).

The means of the experimental data were the following: pH - 5.94 ± 0.12 ; aw - 0.89 ± 0.10 ; moisture - $49.00 \pm 0.63\%$; fat - $15.02 \pm 3.73\%$; protein - $28.11 \pm 1.54\%$; ash - $7.23 \pm 0.63\%$; and $6.04 \pm 0.55\%$ for salt (NaCl).

According to the E.E.C. decision 77/79, Dec. 21th, 1976, the studied sausage is among the products which do not require refrigeration, as the aw values assure stability.

The values for protein, fat ash and salt, were considered normal for this product. A short ripening time and vacuum packaging might have caused high moisture values. Excepting for fat, no significant differences were observed among batches. This variation can be explained by heterogeneity in raw material.

The organoleptic characteristics of the studied smoked sausage were considered normal, the taste and flavour were pleasant; however, it should be stressed that texture and all the other features, would be improved with increased ripening time.

Considering that chemical composition is an indicator of the quality of raw material and technological process, this study has shown the feasibility of making homogeneous products with organoleptic characteristics similar to those of the traditional type. Raw material and technology must, however, obey the quality criteria.

7:8

AGING INDEXES IN "IBERICO" HAM*

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The Non Protein Nitrogen (NPN) fraction and the total Free Fatty Acids (FFA) in 32 samples coming from eight regions of the lean part of four individual IBERICO hams have been evaluated.

NPN content ranged from 2,59 to 3,48 mg/g of ham. The FFA ranged from 2,06 to 3,13 % in the different regions in ham. There were significant differences in NPN and FFA content in the eight regions and individual hams. When expressed in different basis (in the dry matter and total protein basis for NPN and in the % of total fat basis for FFA), a different pattern for proteolysis and lipolysis in ham is shown. The conclusion is that proteolysis varies in different regions of ham depending of the drying process. Lipolysis is basically similar in all the regions, without depending of the drying process.

Although the aging period is very large, the extent of both proteolytic and lipolytic processes in the IBERICO ham is lower than in dry sausage.

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FUR SCHEDULE REASONS,
REVISION NOT COMPLETED

7:9

A STUDY INTO THERMAL-PHYSICAL AND HEAT-MASS-EXCHANGE CHARACTERISTICS OF RAW-SMOKED SAUSAGES DURING MANUFACTURE

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- **The Moscow Technological Institute of Meat and Dairy Industries, Moscow, USSR
- ***The Kiev Technological Institute of Food Industry, Kiev, USSR

Raw-smoked sausages qualitative properties are determined by their thermal-physical and heat-mass-exchange characteristics. Data on changes of thermal-physical characteristics (TPC) of raw-smoked sausages necessary for technological parameters calculation are studied insufficiently. It is for the first time that efficient TPC-heat conduction, heat capacity per unit volume and temperature diffusivity - of raw-smoked sausage are investigated at the temperature range of 5-30°C that corresponds to temperatures of their heat treatment. Measurement of raw-smoked sausages TPC based on the theory of heat-mass-exchange satisfies the method of TPC complex determination. This method is based on the regularities of non-stationary temperature field, namely at sample heating at quazi-stationary thermal regime. Use of thermal-metric TPC-apparatus allowed to model actual conditions

of heat-mass-exchange that are characteristic of raw-smoked sausages manufacturing. Raw-smoked sausages TPC are studied in the abovementioned temperature range. It is found that raw-smoked sausages TPC significantly differ from the similar characteristics of cooked sausages. The obtained TPC values are used for calculation of heat-mass-exchange processes during smoking and drying.

7:10

THE ACTION MECHANISM OF SOY PROTEIN IN DRY SAUSAGE

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Samples of sausage (Italian type) have been evaluated, observing six different manufacturing processes. These processes differed from each other in the quantity of soy protein (0%, 0.6% and 0.9%) and in the carrier for this protein (isolated soy protein or concentrated soy protein). All formulations received an addition of Comb-start (1 package for 300 kg of mixture).

The behavior of the soy protein, in isolated or concentrated form, was very similar in relation to the stimulation of mesophyll aerobic microorganism growth, as well as to the final pH of salamis. All soy protein levels determined a greater increase of this flora, surpassing the 10⁹ ufc/g on the 7th day of the salami processing. In addition, the soy protein when in concentrated form was more efficient as a dehydrater, reducing the humidity - protein ratio to 1.44 - 1.0 and presenting a greater conversion rate (superior to 50%) of the pigments into nitrous pigments with improved final coloration intensity of the salami.

We can conclude that the soy protein reduces the time of salami processing (Italian type) because it stimulates the growth of microbial flora, which stimulates a more rapid reduction in pH value.

THE USE OF A DIAGRAM OF FUNCTIONS OF STATE FOR A COMPLEX EVALUATION OF PRODUCT STRUCTURAL AND HYGROSCOPIC PROPERTIES IN RELATION TO THE PROCESS OF DRYING

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In modern sausage technology various "additives" are used which alter the mechanism of heat transfer during drying and cooking. Thermodynamic and mass-exchange characteristics which are directly related to the hygroscopic and structural properties of products allow to estimate the quality of the product at the end stage of the process and to further optimize its energetic features. Out of the latest computerized numerical methods to describe convective drying, most usefull are those based on the common equations of mass-, energy- and impulse-balance and their simplifications by the developed physical model.

Heat exchange and water removal can be described by means of macroscopic quantities derived from thermodynamic quantitative analysis. The interrelation of the components of comminuted sausage meat to a sausage casing, of water to dry solids is described with thermodynamic functions of state: chemical potential (μ), specific enthalpy of the bound water (H), specific entropy of the bound water (S), iso-steric heat of phase transition (\bar{q}_{i-st}). The diagram of the state of bound water can reflect changes in the properties of a sausage or other products. For this, the values of μ , ΔS , H , (\bar{q}_{i-st}) are laid off on the

diagram which are analytically calculated. The diagram is divided into 3 regions according to the physical model:

$\mu = 0$: the product is indefinitely swel-
lable; moisture content $U \rightarrow \infty$;
 $\mu_{max} = -6 \cdot 10^3 \text{ J/kg}$: the product is in equi-
librium (at $T = 285 \text{ K}$ and $\varphi = 0.4$),
(air-dried sausage);

$\Delta S = 0$: the product contains free water
in the liquid phase;
 $\Delta S > 0$: the product is hydrophobic;
 $\Delta S < 0$: the product contains free water in
the solid phase;
 $\Delta H = 0$: the ideal mechanical mixture of
water with the product;
 $H > 2.5 \cdot 10^3 \text{ J/kg}$: the product contains mainly
adsorbed bound water (pressure and
temperature are constant);
 $H = 2.5 \cdot 10^3 \text{ J/kg}$: water in the liquid phase.

If the differential iso-steric heat of the phase transition (\bar{q}_{i-st}) is calculated from sorption curves, then by the graphic relation of \bar{q}_{i-st} to $\ln \varphi$ the porosity of the product, the casing, the film. The length on the Y-axis cut off by the straight line is equal to the wetting heat.

As the objects of this study served air-dried raw sausage, belcosin, cutisin and cellophane.

RESULTS AND CONCLUSIONS

1. The analysis of the diagram of states makes it possible to predict the mechanism of heat-moisture transfer in the process of drying, as well as product quality to be expected under respective operating conditions of the environment.

2. For the majority of the test objects, the differential iso-steric heat of the phase transition depends on φ as follows:

$$\bar{q}_{i-st} = q_0 - B \ln \varphi \quad \text{at } 0.5 \leq \varphi \leq 0.99.$$

3. The porosity (Π) of air-dried sausage, cellophane, cutisin, etc. was evaluated. E.g., air-dried sausage porosity equals 40% at $T = 285 \text{ K}$ and $0.78 \leq \varphi \leq 0.95$.

4. The singular point on the $\bar{q}_{i-st} - \ln \varphi$ plot corresponds to the beginning of moisture condensation in capillaries.