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Investigations on foil packed cured minced meat resembling raw sausage type

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BACKGROUND: Recently, especially in the six new East German Länder, a new meat product has gained popularity: "Pork and/or beef readily spiced, minced and cured - according to raw sausage type". The cured mince is packed in air and steam proof plastic with an expiry date of two to three weeks. As sodium nitrite has been added to the mince, the meat has gained the colour of cured meat.

OBJECTIVE: In connection with this relatively new meat product, the question arises whether or not the product is governed by the German minced meat by-law or whether it is regarded to be a satisfactorily cured meat product. Aim of the research was to investigate whether the products when marketed commercially showed the stabilizing features of sausage maturation. In addition we wanted to find out which would be the parameters to characterize the stabilizing elements of raw sausage maturation.

METHODS:
Sampling material were 42 packages, bought in supermarkets in Berlin, of the above described cured minced product, of minced pork to which salt had been added, as well as of minced pork without any additions. Besides the above described commercially manufactured samples, parallel investigations were carried out on the same type of samples produced in our meat technology laboratory. Storage temperatures of all samples were +4 °C and +7 °C.
Microbiology: Microbial counts were carried out under standardized conditions using Plate-Count Agar, Cristall-Violett-Red-Bile-Glucose-Agar, Hektoen-Agar, Sorbic-Acid-Agar, Glutamat-Starch-Phenol-Red-Agar, Baird-Parker-Agar, Streptomycin-Inosit-Neutral-Red-Agar, Trypton-Sulfit-Neomycin-Agar.
Impedance: The impedance was measured by using the BacTrac 4100 in combination with the software BacTrac, version 4.10 of Sylab.
Lactic Acid Determination: In accordance with the German Official Collection of Laboratory Methods for the Investigation of Foods (according to § 35 of the German Food Law) D- and L-Lactic Acid was measured by using enzymatic determination in combination with spectrophotometry.
Water Activity: The water activity was determined, using the Rotronic Hygroskop DT, station WA-14 TH.
pH: The pH of the various meat samples was measured by piercing the meat with an electrode CG 820 (Schott).
Determination of colour: The meat colour was determined by using a Chroma-Meter CR-210 (Minolta).

RESULTS AND DISCUSSION
The investigations show that cured minced meat products can only then be considered to be raw sausage, if they reach the characteristics of sausage by change of colour, aromatization and meat binding capacity as well as through the resulting preservation effect. In case one or some of the above features are insufficiently developed, we are presented with a pre-raw sausage product (governed by the German minced meat by-law), with a high hygienic risk, a product representing a health hazard through the growth of pathogenic microorganisms, e.g. Salmonellae and Staphylococci (3, 6).

Only then is the antagonistic activity of the Lactobacilli (especially of homofermentative Lactobacilli) reliable towards the associated flora of the product, if the microbial counts reach values of $>10^8$/g. The suppression of the antagonistic flora is based upon the enrichment of lactic acid, which is a metabolic product of carbohydrates. The lactic acid production, however, is retarded in comparison with the increase of microorganisms. The maximum in lactic production is only reached during the late stationary pase of the culture (10, 11). The above described reaction is the reason for demanding a maturation time of two days for fresh "Mettwurst" type products, even if carbohydrates and starter cultures are used (1, 8, 9, 19, 20). Is the product marketed before the two day maturation time has passed, the stabilizing element of acidification is missing or has not yet developed sufficiently although the Lactobacilli are present as dominating flora. For determining the degree of maturation, the bacterial count as a parameter is only of limited reliability.

The state of maturation of a sample can be better be assessed if its bacterial count is put in relation to its metabolic ability. A suitable method for the combined detection is to measure the impedance by measuring the change in the electric resistance of a fluid culture medium into which dilutions of the homogenized sample had been pipetted (8, 9, 20). During the growth and multiplication of the culture the changes in the electric resistance are monitored as a function of the incubation period. Detection curves with a flat inclination (increase <3,5 %) indicate the metabolism of a dominant acidifying flora. The counts of Gram negative microorganisms of such products are usually $<10^3$/ and do not indicate any hygienic risk.

Steep detection curves (increase >4%) allow the conclusion of unsatisfactory stabilization (Tab. 1). It is the metabolic activity of the Gram negative organisms which determine the course of the curves. Enterobacteriaceae especially are present in higher numbers (range $>10^4$/g), whereas the flora representing the state of maturation is underrepresented, indicating al lower metabolic activity. A further advantage of the impedance method is its time saving factor. Compared to the classical culturing methods of microorganisms it can be regarded as a fast method (investigation time 16 - 20 hrs). Although the degree of maturation of a product can in most cases be determined by the course of the curve (degree of increase), it is recommended to regard measuring the impedance as a screening test. As a confirmation, especially in view of the demands of the minced meat by-law, further objective analytical parameters should be taken into consideration, e.g. pH, change of colour, amount of lactic acid.

The D(-)-lactic acid content (approximate value for matured products: >0,22 g/100g product) (8, 9) is of paramount importance (Tab. 1). This metabolite is produced exclusively by bacterial processes during raw sausage maturation. The concentration of D(-)-lactic acid is very closely related to the count of lactic acid bacteria and the pH of a sample. As the L(+) lactic acid, which is produced during glycolysis shortly after slaughter of an animal, will also be present in the raw sausage meat (5, 8, 9, 15), it is obvious that the level of L(+)-lactic acid is less apt to assess the state of maturation. The pH as a single parameter is not suitable to express the state of maturation (1, 4, 7, 17, 17). GdL, citric acid and/or other acidifying agents (all leading to al lowering of the pH) when added to a product, would simulate a satisfactory state of maturation. Finally it is worth mentioning that the change of colour is an indication for a product being cured, however, the change of colour is by no means a parameter of the hygienic safety of the product.

Tab. 1: Limiting value for the amount of D(-)-lactic acid and limiting values for the increaese of impedance (Reinschmidt, Jöckel and Hildebrandt, 1993)

D(-)-lactic acid [g D(-)lactic acid/100 g sample]	
≤ 0,22	maturation slightly pronounced
> 0,22:	maturation pronounced
Increase in Impedance [%]	
≥ 4:	maturation slightly pronounced
≤ 3,5:	maturation pronounced

Thus the organoleptic appearance of cured meat would exclude the raw sausage product from the German minced meat by-law, but the product itself might not jet have the characteristics of a classical raw sausage.

CONCLUSIONS

The product "cured pork, readily spiced, minced and cured - raw sausage (Mettwurst) type" - undergoes, just like other raw sausage type products a maturation process. It has been shown that the stabilizing elements of maturation can be assessed. Above all other parameters, the results of impedance measuring are indicative of this product being sufficiently matured.

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