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DATA CONCERNING THE MICROBIOLOGICAL AND CHEMICAL CHANGES OF THE GYULAI TYPE SAUSAGES IN COURSE OF THEIR RIPENING.

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The Hungarian sausage of Gyula is a meat-product made of pork-meat, fatty tissue /perhaps some boef/, salt and flavoring adequate to the character of the product. It is made without heat-treatment and filled into a casing of at most 4o mm diameter.

The watercontent of the commercial product is at most 36 %, its fatcontent related to 3o % watercontent at most 46 %, its proteincontent at least 18 %, its caloric value at least 4oo cal/1oo g.

In order to examine these meatproduct we prepared three lots of sausages with the customery technology. From each lot we took in course of 21 days daily samples for mircrobiological and chemical analysis.

The total number of the microbds was determined by the dilution method of Pasteur and Koch's plate method. For the former meatpulp + dextrose + yeast

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+peptone bouillon was used and to detect the anaerob bacteria we prepared Kitt-Tarozzi's liversoup with the above mentioned bouillon, which we sealed by the aid of paraffine-vaseline mixture. The plating was performed on gelatine + agar substrate made of the above bouillon, on which we also determined the number of proteolitic microbes.

The obligate anaerob clostridia were examined also on sulfite culture medium. The number and titer of the coli-aerogenes straines was determined on Klimmer's agar, resp. on Kessler-Swenarton's substrate.

The examinations on salmonellae were performed by spreading Bierbauer's enrichment on phenol-red-brilliantgreen as well as on Drigalski's agarplate.

In order of qualitative bacteriological determination we made subcultures from the dilutions on Drigalski's and gelatine agarplates and on blood-plates containing o,1 % dextrose.

The developed colonies were examined for katalaze enzyme also. The lactobacillae were cultivated on 29 C^{o} in a bouillon with pH = 6,o containing cistine.

The average value of the number of bacteria was not related with the ripening time: after

24 hours the number was 10^4 /aerob/ and 10^7/anaerob/ and after 48 hours in both cases with 4 orders higher. The dispersion is for all four distributions was in the magnitude order of 4. This results are directing our attention to the fact, that the number of living microbes in the fully ripe sausage can also be large ; consequently those views are not justifiable, which connecting the socalled biological ripeness of the sausage with a definite number of germs, i.e. the ripe sausage must not pass beyond a certain level of bacterial count. Often occur in "ripe" products, that the number of living microorganisms reach the numerical grade of 10^{10}.

The other characteristics: the pH-value of the product, its water- and saltcontent are correleted with the course of ripening. To prove this relation we made rating correlation counting, because these correlations in most cases are not linear. For this characteristics, which show only in the first period of ripening striking changes, we performed separately the examinations in the first and second periods of ripening.

In the beginning period of ripening the changing of the total number of microbes, of the number of Gram-negatives of the pH and of the watercontent is

significantly monoton /o,27 % level/, the change of the saltcontent may only just be proved statistically /5 % level/.

In the second period of ripening only the decreasing of watercontent may be shown /o,1 % level/, the other characteristics may be considered as constant.

The number of microbes determined by the plate method decreases during the beginning period of ripening from 10^{10} to 10^{6}. The average number of microbes is furthermore about the order of 10^{6}, but the dispersion increases to 4 instead of order 2 obtained at the end of the first period. Thus to judge the end of the ripening process, the individual plate method is not adequate, but the tracing up of the whole ripening process shows, that in course of the microbiological life of the sausages in a certain period a change occurs /in our experiments on the 7 - 9^{th} day/ and further on there is no unambigious change in the number of microbes. Likewise the Gram-negative microbes disappear on the 7^{th} day, further the pH settles on a value about 5,9 and the saltcontent on 3,9 % at the same time. This indicates that not only the microbiological processes, reflected by the number of microbes, but also the chemical processes causing the changes on the pH value, come to a standstill in the same period of ripening.

It is advisable beside or instead of determining the salt resp. watercontent to examine also the salt/water ratio. This ratio shows the "real" saltconcentration, because the salt is solved in the watercontent of the product and only this salt solved in the watercontent is effective.

The change of the other characteristics is considerable and is the consequence of increased effective saltconcentration creating changed circumstances for the microflora.

This is proved by the fact, that between the number of microbes, determined by Koch's plate method, and the saltconcentration there is a strong correlation during the whole ripening period, while no strong corelation exists between the number of microbes and water- and saltcontent or even the ripening time. The considerable protective offect of the filling as medium is shown by the circumstance that above 22 % "real" saltconcentration the number of microbes is high, while in saltsolutions even in case of minor concentrations a decreasing of microba-number takes place.

The correlation between the number of Gram-negative microbes and salt/water ratio is not so strong as between the number of microbes and the time, so we must come to the conclusion, that the decreasing

of the Gram-negative microbes is not only the function of the increased saltconcentration but also of other factors /for instance pH/. The number of Gram-negative microbes shows the same strong correlation with pH as with time.

The unambiguous discerning of the role of each characteristic is difficult, because especially in the early phase, the saltdistribution is very inhomogen, which is shown also by the great changes of the salt/drysubstance ration /3,8 - 5,8 %/. This fluctuations decrease towards the end of ripening, showing the effect of the equalization processes in the sausage. These processes may be observed also with the salami.

Chemical values towards the end of the ripening period, which may be demonstrated by microbiological experiments, are as follows: pH = 5,8 - 6,o; salt/water ratio 13 - 16 %, which corresponds to 25 - 28% watercontent. That is much lower as the originally standardized 36 % and corresponds to 3,5 - 3,9 % saltcontent. In our experiments we got these data on the 7 - 9th day. From this time on the pH and saltcontent became steady in the order of the given value. This phenomenon is in case of salt surprising, as one could count with the increasing of the saltcontent

because of the drying process. This question must be examined further on, because it is possible that the unsteadiness of the saltcontent covers the slow increasing of the saltcontent. In course of the organoleptic examinations of the ripened product was stated, that on the 7 - 9th day the ripeness is not satisfactory and only 1 - 2 days afterwards, resp. at a watercontent of 24 - 26 % it becomes adequate.

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183

Mikrobiologiset ja kemialliset muutokset gyulai-tyyppisen makkaran kypsymisen aikana.

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Gyulai: sianlihaa, rasvaa, NaCl, mausteita. Ei lämpökypsennystä. Suoli halkaisija 40 mm.

Valmis tuote: vettä n. 36 %, rasvaa n. 46 %, valkuaista vähintäin 18 %, ravintoarvo vähintäin 400 cal/loo g.

Kokeet: 3 tavallista valmistuserää, jotka päivittäin 21 vrk:n aikana tutkittiin mikrobiologisesti ja kemiallisesti.

Menetelmät:
- kok.bakt. Pasteurin laimennusmetodi ja Koch-levymetodi
- anaer.: Kitt - Tarozzi-maksaliemi + lihaliemi, paraff. + vaseliini.
- proteolyytit: gelatiiniagar, lihaliemi
- oblig.anaer.: sulfiitti alustalla
- coliaerogenes: Klimmers agar.
- Salmnnella: Bierbaner, Drigalski.

Myös tutkittiin pesäkkeiden katalaasientsyymi. Laktobasillit tutkittiin lihaliemessä, 29°C, pH = 6,o sisältäen kystiiniä.

Tulokset:

Bakteerimäärät eivät olleet suhteessa kypsymisaikaan. Esim. 24 t: aer.= 10^4, anaer. 10^7 ja 48 t: molemmat 4 astetta korkeammat. Tulokset osoittavat, että mikrobien määrä voi olla hyvin korkea valmiissakin makkarassa. Usein voi kypsässä tuotteessa olla elävien mikrobien määrä 10^{10}.

pH, vesi- ja suolapitoisuus ovat suhteessa kypsymiseen. Ei linearisesti - alussa muutokset ovat voimakkaat.

1 vaihe: mikrobien kokonaismäärä, pH ja vesipitoisuus muuttuvat monotonisesti (0,27 % level). 2 vaihe: vain vesipitoisuus vähenee (0,1 % level), muut karakteristikat ovat paikallaan. Muutoskohta on n. 7-9 vuodokauden paikkeilla (silloin mm. gram-mikrobit häviävät, pH on

184

saavuttanut arvon 5,9 ja NaCl 3,9 %). T.s. mikrobiologiset ja kemialliset prosessin hiljentyvät ko. aikana.

Mielenkiintoista on tutkia suhdetta suola/vesi. Tämä suhde osoittaa "todellisen" (real) suolaväkevyyden, koska suola on liuoksena ja vain liuennut suola on tehokas (effective).

Tehokas suolaväkevyys aiheuttaa muutoksia mikrofloran olosuhteisiin. Esim. on selvä korrelaatio kok.bakteerien ja suolaväkevyyden välillä koko kypsymisen aikana, kun taas ei ole korrelaatiota pelkän vesipitoisuuden ja suolapitoisuuden kanssa. Jos "todellinen" suolaväkevyys on yli 22 %, mikrobien määrä on korkea, kun taas pienissä väkevyyksissä mikrobien määrä vähenee.

Korrelaatio gram-mikrobit ja suola/vesisuhde ei ole yhtä selvä kuin välillä mikrobit ja aika. Päättelemme siis, että ko. suolakonsentratio ei yksistään vaikuta gram-mikrobien vähenemiseen vaan myös muut tekijät esim. pH. K.o. mikrobit korrelcituvat selvästi ajan ja pH:n kanssa.

Kypsymisen lopulla: pH = 5,8-6,o; suhde suola/vesi = 13-16 %, mikä vastaa 25-28 %:n vesipitoisuutta. (Nämä arvot saavutettiin jo 7-9 vuorokaudessa.)

Organoleptisessa arvostelussa todettiin, että 7-9 vuorokaudessa ei kypsyminen ole täydellinen, vaan vasta 1-2 päivää myöhemmin, jolloin vesipitoisuus on 24-26 %.