SESSION 6. TECHNOLOGY OF HEAT PROCESSED PRODUCTS

6:1

THE EFFECT OF VARIOUS HYDROCOLLOIDS ON THE PROPERTIES OF MINCED MEAT PRODUCTS

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The effect of adding various carrageenans, either kappa, lamda, or mixtures of kappa and lamda, or locust bean gum, guar gum, or xanthan gum to minced meat products (models) was tried out. In most cases the hydrocolloids were added together with trisodium-polyphosphate (TPP) in a concentration of 0.3 to 0.4%.

The effect was assessed based on measurements of water holding capacity (WHC), jelly formation, and the texture. Some selected samples were also assessed by sensory evaluation.

The minced meat models had the following composition: 38.5% lean pork meat, 30.9% back fat tissue, 28.6% ice/water, and 2% sodium chloride. The mix was added the hydrocolloid in question, stuffed in an artificial casing and heated to 72°C after being filled in polyester casing to avoid moisture loss to the cooking water.

The effect of the hydrocolloids were tested on the models after chilling to 5°C.

Some additional trials were made with model sausages with a basic recipe as follows: 42.9% pork meat, 30.9% fat tissue, 23.8% ice/water, 2% sodium chloride, and 0.4% TPP. The sausages were also added one or more of the hydrocolloids mentioned above.

Before these models were evaluated, they were either chilled or frozen for two weeks or heated to 111°C.

The main results were as follows:

Although xanthan gum resulted in excellent WHC, the products showed poor texture. Similarly, guar gum was found to be less suitable because it gave a weak gel and poor texture.

In combination with TPP the best properties were found with locust bean gum or carrageenan.

However, if the products were heated to high temperatures, this impaired the locust bean gum product.

In conclusion therefore, 0.25% carrageenan together with 0.3 to 0.4% TPP seems to improve the properties the most with regard to WHC and texture, when the sausages were subjected to high temperatures or freezer storage before evaluation. Differences were only found by sensory evaluation in samples added xanthan gum when comparing with a control sample.

6:2

ABOUT THE INFLUENCE OF METAL IONS ON THE STABILITY OF FRANKFURTER TYPE SAUSAGES AND THE EFFECT OF CITRATE

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Frankfurter type cooked sausages were prepared with 34% beef, 34% ice, and 30% pork back fat. Salt concentration in the batter was 2%. The finely comminuted batters were filled in 200 g cans, sealed and heated to core temperatures of 90°C. Further additives were added with the salt. Jelly and fat separation were measured gravimetrically.

Depending on the type and concentration of metal ions the jelly and fat separation varied. 5×10^{-3}M Mg-II and 3×10^{-3}M Ca-II-ions showed no effect on the binding characteristics of the cooked sausages. Bivalent cations of Hg, Zn, Ni, Pb, Fe, and Cu-I-ions caused at concentrations of 5×10^{-4}M no effect on jelly and fat separation. Above 10^{-3}M up to 10^{-2}M these ions, however, increased jelly and fat separation up to 70% compared with the batter without addition. Co-II, Fe-III, Cd-II, Cu-II and Ag-I ions on the other hand enhanced already at 5×10^{-4}M the cooking loss by 17 to 95% increasing in the order mentioned. With concentrations of 10^{-2}M the jelly and fat separation increased further (26 to 100%).

By the addition of 0,3% citrate (1.1×10^{-2}M) the jelly release decreased by about 30%.

Addition of metal ions with concentrations of 5×10^{-4}M had no effect except with Ag-I ions which increased the jelly release by about 100%. With 10^{-2}M metal ions Ni-II, Fe-III, and Co-II showed no effect; with all other ions the jelly and fat separation increased by 75 to 150% reaching about the level of batters without citrate in the presence of these cations.

Citrate binds metal ions. At naturally occuring concentration of metal ions of 10^{-3}M and lower the effect of citrate may be due to the binding of cations. This may be the mode of action of citrate in cooked sausages enhancing the fat and water binding of the batters. At concentrations above 10^{-3}M when besides the metal citrate complex small amounts of free ions exist, the water and fat binding of cooked sausage batters is reduced by the ions.

We propose oxidative effects on SH-groups of myofibrillar proteins as the cause. Experiments with Cu-II and Fe-III showed that the free SH-groups in the batters are markedly reduced. Fe-II-salt, however, had no effect. Other functional oxidation sensitive groups may be involved.

A hypothesis about the mode of action will be presented.

6:3

UTILIZATION OF CARRAGEENAN AND GUMS IN THE MANUFACTURE OF HAMS

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OBJECTIVE

Carrageenans are added to meat, as other ingredients, in order to improve water retention in the finished product, through their ability to hold water after heat treatment and gelling.

The effect of the utilization of different mixtures of carrageenans and gums, as well as pure carrageenans as commercially available, in hams is studied in this paper. The effect of the method of application is also considered.

EXPERIMENTAL

4 different carrageenans were evaluated: 1) kappa carrageenan with different levels of 3-6 anhydro-galactoseand 30% locust gum; ii) a mixture of pure carrageenans; iii) 100% kappa carrageenan and iv) a mixture of 60% kappa carrageenan, 30% locust gum and 10% calcium lactate.

Molded hams were prepared at pilot plant scale with 35% added pickle, including 0.3% carrageenan.

Two methods were used for pickling:
a) multi-needle injection + massaging and
b) massaging. Process included two 60 minute alternating massages, 24 hours curing and cooking to 70°C in the center of the product.

Weight losses were determined and textural properties measured in an Instron machine. Sensory evaluation included appearance, texture and flavor, by a 7-point scale.

Results were evaluated by analysis of variance.

RESULTS AND CONCLUSIONS

Cooking losses were not affected by carrageenan type, but the method of application had a significant effect, a) giving 2.2% less cooking loss.

No significant differences were appreciated either between carrageenan types for instrumental texture measurements or sensory evaluations.

Sensory evaluation of texture did give significantly different results ($p < 0.05$), though, for the different manufacturing methods, a) receiving an average score of 5.65 and b) 5.2 on the 7-point scale.

6:4

FAT HOLDING PROPERTIES OF PORK BACK FAT AND BEEF FAT - AS INFLUENCED BY COMMINUTION AND HEATING

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Fat separation in meat products such as hamburgers, sausages and liver paté can cause quality problems. Only a few systematic studies are to be found in the literature regarding this area of research. The work presented in this paper was undertaken with the purpose of investigating this subject further.

When the fatty tissue is disintegrated during the production of the meat product the fat can be found in roughly two forms. Firstly, the fat remains in its natural fat cells as single cells or in aggregates. Secondly, the fat can be squeezed out of the cell and dispersed into the surrounding meat batter in the form of small droplets or larger fat pools. The question is then, how will the fat be distributed between the two forms and what degree of dispersion should exist within the forms in order to obtain a high fat holding capacity in a meat product. In this investigation we have tried to elucidate this problem by following qualitatively how the fatty tissue behaves under the light microscope during the processes that it is subjected to during production, i.e. during comminution and cooking. Additionally, the stability against fat separation (coalescence stability) of the different forms of fat has been followed in a quantified way. This has been carried out by measuring the percentage of fat extracted by hexane, as it has been shown for protein stabilised emulsions that the degree of hexane extraction of the emulsion is a reflection of coalescence instability. In this investigation we have made these types of measurement on the fat raw material alone. The most commonly used fat sources in meat products, such as pork back fat and beef fat, have been studied.

The principal results of this investigation are as follows. An increasing degree of comminution of both pork back fat and beef fat gives rise to a higher hexane extractability. With the same type of comminution beef fat is more susceptible to damage, as revealed by hexane extraction, than pork back fat. This difference between the two types of fat studied is especially pronounced when the fatty tissue is disintegrated in a grinder (10 mm plate). The Moulinex mixer gives rise to the highest degree of comminution, whereas dicing by hand with a knife causes the lowest. Heating the disintegrated fatty tissue to 75°C causes further instability, which for all degrees of comminution is more severe for beef fat than for pork back fat. The higher susceptibility to heat for beef fat is especially clearly expressed when the fatty tissue samples are disintegrated in a bowl chopper.

When the course of comminution and heating is followed qualitatively under the light microscope the following can be noted. The fat cell integrity can always be seen somewhere within the sample for all the differently comminuted fatty tissues except for those chopped in the Moulinex. The latter samples have a completely destroyed structure, the fat having smeared out all over the sample. The most striking event during heating of the fatty tissue is the contraction of the connective tissue, starting at 50-55°C and being most severe after 65°C. This does not occur, however, in the completely disintegrated connective tissue in the Moulinex sample. Additionally, this contraction of the connective tissue is greater for the beef fat than for the pork back fat. This observation could be one of the reasons for the fat holding capacity of the beef fat being lower than that of the pork back fat on heating.

6:5

Identification of the Interfacial Proteins in Meat Emulsions

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It is not known with certainty which proteins lie at the fat-water interface in meat emulsions. Several lines of evidence suggest that "salt-soluble" muscle proteins play a major role in emulsification. In particular myosin has good emulsifying properties, and so it has been suggested that it is the most important interfacial protein (reviewed by Schut, J (1976) in "Food Emulsions", Friberg, S. Ed, Marcel Dekker Inc, New York, Chap 8, pp 385-458).

We have identified the interfacial proteins in a meat emulsion directly by treating it as a protein purification problem to be overcome using traditional protein biochemical techniques. The methods used to purify myofibrillar proteins from muscle were adapted to enable the separation of all the matrix material from the emulsified fat particles of a meat emulsion. The matrix material was extracted by repeatedly dispersing the emulsion, first in a high-ionic-strength solution used for solubilising myosin and other myofibrillar proteins, and then in a low-ionic-strength actin-extraction buffer. Emulsified fat particles were harvested by differential centrifugation. The interfacial proteins were isolated from the matrix-free emulsified fat particles by organic solvent extraction of the fat, and identified by sodium-dodecyl-sulphate 10%-polyacrylamide-gel electrophoresis.

Polypeptide chains with apparent molecular weights of 205000, 140000 and 120000 in this system were observed. These were identified as myosin (heavy chains), C-protein and α-actinin respectively. Myosin was the major component of these interfacial films, but the other two proteins were enriched in relation to their abundance in muscle. The reasoning behind this experimental strategy and the implications of the results will be discussed.

6:6

THE EFFECT OF SWOLLEN MYOFIBRILS ON THE RHEOLOGY OF PROTEIN GELS

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Myofibrils are long thin cylindrical rods, which in muscle have a diameter about 1 μm. Under conditions of high (I>0.5) ionic strength particularly in combination with high pH's, myofibrils will swell radially and concomitantly with this swelling process, proteins will be extracted. It has been suggested that this swelling process is fundamental to the water holding of meat products. On heating myofibril suspensions the extracted proteins will gel resulting essentially in a two phase system consis ting of swollen myofibrils in a protein gel.

This gelation process has been studied by measuring dynamic rheological parameters (G' and G") as a function of temperature using a Bohlin rheometer. Information about the temperature of gelation and the effect of pH and ionic strength on the storage modulus (G') has been obtained. The myofibrils studied were isolated from beef M.cutaneus trunci. Washed, sedimented myofibrils were pH and ionic strength adjusted by dilution with appropriate solutions. The distribution of proteins between the myofibrils and the continuous phase of the gel has been determined. Using this information in combination with results from investigations on the rheology of both myosin and myosin-actin gels, the value for G' for the heated suspensions has been predicted assuming the rheology is dominated by the continuous gelled phase. Under conditions of high ionic strength and pH 7 where the amount of extracted protiens is maximal, that assumption seems to be justified.

Further information on the possible role of myofibrils as fillers in gels has been obtained from a study of gelatin gels in which myofibrils have been incorporated.

6:7

MICROSTRUCTURE OF PORCINE MUSCLES AFTER SCREW PRESS MECHANICAL TREATMENT

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The studies presented treat of the possibilities of an original physical method of the technological treatment of meat based on its pressing using the screw of the grinding machine which is rather common in meat processing plants. Cooled pork from the hind leg cut into pieces sized 15 x 20 cm, was processed in a grinder, in which the cutting elements were removed at the outer end of the screw. Meat was cured using the brine and treated two more times in the grinder as described above. The meat treated thus was filled into rectangular cans of a capacity of 5 kg. Heat treatment took place at 90° + 95°C, through cooking.

Comparative analyses were made using the Semimembranosus muscles of the same animals. Muscles derived from left hams were subjected to the treatm ent described above, and right ham muscles were treated by brine injection using multi-needle injectors and tumbling in Laska tumblers.

Materials for histological analysis were frozen in isopentane pre-cooled in liquid nitrogen. Histological preparations were stained with haematoxylin-eosin and observed using a Docuval-Carl Zeiss (GDR) light microscope.

Electron microscope studies were conducted using ultra-thin sections contrasted after Reinolds (1963) and observed using a Tesla-BS 613 transmission electron microscope at 80 kV.

Upon the micro- and ultra-structural analyses conducted of hams made of parallel muscle samples, marked destructive changes were observed in muscle fibres, typical of a well processed ham. What was characteristic of the method under investigation was the transverse splitting of muscle fibres throughout their thickness, and the undulation of myofibrils in the muscle fibres themselves. Myofibrils were sticking closely together, with eliminated boundaries between them. Some sarcomeres were completely transformed into a homogenous proteinaceous mass.

On the basis of the microstructural studies conducted, conclusions were made on the efficiency of the investigated method of the mechanical treatment of meat using the screw.

6:8

THE INCIDENCE AND USE OF BRUISED BEEF IN MEAT PRODUCTS IN TROPICAL AFRICA

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The extent and nature of bruising in beef carcases were surveyed in five abattoirs in three African countries. Variations were found in the procedures for handling the damaged tissue and its nature but losses in the weight and value of the downgraded material were considerable in all cases. It was believed that value could be added to the trimmed material if it were to be incorporated into meat products.

Tissue removed during post mortem inspection was incorporated into beefburgers, beef salami and blood puddings at different levels to study the effect on product quality. Chemical, microbiological and organoleptic parameters were measured. All products were shown to be microbiologically sound. At the 10% inclusion level, beefburgers had higher overall acceptability markings and the appearance of the beef salami was marginally enhanced. Bruised tissue was unnoticed in blood pudding. The colour of the cooking exudate from the beefburgers was darker where bruised tissue was present and this might be aesthetically unacceptable.

It was concluded that some types of bruised tissue can be used safely in meat products and this could help to reduce some post harvest losses in the meat industries of Africa. The difficulties of collection, however, may be a constraint. Removal of bruised tissue from the carcase must be conducted as an exercise separate from that of condemned tissue by specially trained staff in a factory which has the ability to sort the material and manufacture marketable meat products.

6:9

THE EFFECT OF COLLAGEN ON THE STABILITY AND RHEOLOGICAL PROPERTIES OF COOKED SAUSAGES

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Raw collagen isolated, from the connective tissue membrane covering the bovine round, or an emulsion prepared from this collagen after precooking and mixing with pork fat and water in proportions 1:1:1, was used in finely comminuted meat sausage formulations, at various concentrations. The mixture contained 11 to 15 % crude protein, 16 to 35 % fat, and 2 % NaCl. The sausage formulations were filled into collagen casings, 35 mm in diameter and heated in a water bath at 65 to 90 ^{o}C.

The stability of the cooked products was determined by measuring the expressible fluid and free drip. The rheological properties of the sausages were characterized by the yield limit using a penetrometer with a flat punch.

Substitution of meat by collagen in comminuted sausage formulations caused in all experiments a significant increase in cooking losses, regardless the composition of the mixture. However, in properly prepared formulations such substitutions did not bring about instability of the system and accumulation of fat or loose gel under the casing. Substitution of up to 40 % of meat proteins by collagen - fat emulsion increased the cooking losses and decreased the yield limit more than corresponding amounts of raw collagen. No significant difference in the effect of cooking temperature on the stability of the system containing raw collagen or precooked collagen - fat emulsion, was found. On the other hand an increase in temperature of the formulation in the silent cutter above 16 ^{o}C causes instability of the products after cooking in control samples and in both experimental systems.

The results of these experiments indicate that although collagen impairs the binding and gel forming capacity of the formulation by diluting the myofibrillar proteins in the system it must not necessarily cause a deterioration of the texture of the sausages. It is possible to substitute a large part of meat proteins in a sausage formulation by collagen without abuse in quality of the product, by taking into account in the material calculations the functional properties of the meats.

6:10

CHANGES IN EXTRACTION CHARACTERISTICS OF MUSCLE PROTEINS DURING COOKING OF MEAT

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Proteolytic degradation of muscle proteins is believed to contribute to tenderisation and flavour development in meat. Alterations in muscle proteins may be detected using SDS-PAGE separations of muscle protein extracts. However, during cooking of meat, proteins undergo changes in extractability by the conventional procedures. The present study was undertaken to characterise these changes.

Fresh and aged bovine sternomadibularis muscle was extracted before and after cooking. Extracts were made in 0.0153M and 0.230M phosphate buffer pH 7.4 and in 4% w/v NH_4OH. Drip was also collected from the cooked muscle. Protein contents were determined by the Biuret method. Extracted proteins were separated by SDS-PAGE, and stained with Comassie Blue.

In fresh and aged muscle, protein analysis showed that 26% muscle protein was extracted as sarcoplasmic, 30% as myofibrillar and 44% as residual proteins. Cooking at 80°C for 7.5 min and for 60 min drastically altered the extractability of these proteins. After 60 min 2% of muscle protein was found in the drip, 9% in the sarcoplasmic fraction, 14% in the myofibrillar fraction, 70% in the residual extract and 5% was not extractable by the procedures used. SDS-PAGE profiles of extracts showed that cooking rapidly altered the extractability into buffer solutions of sarcoplasmic and myofibrillar proteins. These proteins which were not thus extracted in buffer appeared in the residual fraction extracted with NH_4OH.

It is concluded that cooking of muscle does not alter the electrophoretic mobility of individual muscle proteins. Cooking does, however, alter the extraction characteristics of individual proteins so that a modified extraction procedure will be necessary to follow the fate of sarcoplasmic and myofibrillar proteins during cooking.

6:11

CHANGES OF PHYSICOCHEMICAL AND MICROBIOLOGICAL PARAMETERS DURING CONTROLLED PRODUCTION OF HIGH QUALITY FRANKFURTERS.

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The objective of this study was to determine the changes which occur during controlled optimum commercial processing conditions with formulation suitable for high quality frankfurters. The formulation consisted of 37.04% lean frozen beef, 14.82% fresh pork meat, 22.22% pork back fat, 18.52% ice/water, 1.85% salt, 0.01% sodium nitrite, 0.11% ascorbic acid, 0.25% polyphosphates, 3.70% potato starch, 0.82% sugar, 0.22% sodium caseinate, 0.18% white pepper, 0.15 red pepper and 0.11% nutmeg.

Samples at the end of each of the following processing steps were examined: A) coarse chopping of meats for 3 min B) addition of salt and other dry ingredients with slow chopping until temperature reached 4°C C) addition of pork fat and ice/water with high speed chopping until temperature of batter reached 14°C D) stuffing the batter into cellulose casings of 25 mm diameter and 10-12 cm length E) reddening at 30°C with 50% RH for 25 min F) drying at 60°C with 30% RH for 25 min G) smoking at 70°C with 30% RH for 40 min H) cooking to an internal temperature of 72°C for 5 min followed by showering until internal temperature reached 25°C and I) chilling for 24 hrs at 2°C with 70-75% RH.

Moisture and fat content were determined according to AOAC procedures. Weight loss was expressed as a percentage of the difference in product weight. Color was determined with Labscan spectrocolorimeter model LS5000. Results were expressed as L (lightness), a(+) (redness), b(+) yellowness, and ratio a/b. Product pH was determined in the sample slurry prepared by blending 20 gr sample with 180 ml distilled water. Microbial counts were obtained by plating using the following media and incubation conditions: a) for total aerobic count APT agar (Merck) at 25°C for 3 days b) for lactic acid bacteria Rogosa L.S. agar (Merck) at 25°C for 3 days c) for micrococci and staphylococci Manitol Salt agar (BBL) at 37°C for 2 days d) for Enterobacteriaceae Violet Red Bile Glucose agar (Merck) at 37°C for 24 hrs and e) for Staphylococcus aureus Baird Parker agar (Merck) at 37°C for 48 hrs.

The results showed that the weight loss during the production of frankfurters amounted to 10.23% while the moisture content of the batter (60.80%) decreased by 5.74 units. The final moisture content of the frankfurters in step I was 55.06% while the fat content on dry basis was 57.96%. Both values are within the limits set by the Greek Food Law. The pH of the meats (step A) was 5.9 while that of the batter (stepC) was 6.13. During heat processing a further increase of 0.22 units was found bringing the pH of the final product to 6.33.

In step A a bright red color developed while in step B a significant ($P<0.05$) decrease of a(+) value and of the ratio a/b was observed. In steps E, F and G a continuous significant increase ($P<0.05$) of the a(+) and b(+) values as well as of the ratio of a/b was observed. The L value showed an important increase in step C and decreased($P<0.05$) in steps E, F and G In step H a considerable increase in L value was observed without affecting the red color of the final product.

In step C the total aerobic mesophilic count was raised to $5.7X10^7$/gr, that of micrococci and staphylococci and enterobacteriaceae to $1.0X10^4$/gr, of the lactobacilli to $2.8X10^2$/gr and of the S. aureus to $2.6X10^2$/gr. Main source for the above microorganisms were the meat and lard. In step H the count of mesophiles was reduced by 4.1 log cycles while the destruction of the lactobacilli, enterobacteriaceae and S. aureus was complete. The population of the micrococci and staphylococci which survived was reduced by 1.4 log cycles. In step I there was no change in the counts.

6:12

THE EFFECT OF FREEZE STORAGE AND SALT CONCENTRATION ON EMULSIFYING CAPACITY OF THE PIG BLOOD PLASMA

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SUMMARY

Freeze storage of the pig blood plasma at -18°C for 3 months and the kind of fat/rapeseed oil and lard/used for analysis influence the emulsifying capacity /EC/ of plasma proteins. NaCl conc.of:0.9,1.5,2.0,2.5 and 5.0% does not improve fat emulsification. Alkalization of plasma during first 2 months of storage was highly correlated with better EC /r=0.999/.Higher value of EC was determined when rapeseed oil was used for analysis, instead of lard.Freeze storage resulted in agglomeration and formation of fluffs,suggesting denaturation of plasma proteins,although not detrimentally influencing EC.

INTRODUCTION

Freezing and spray-drying are commonly applied in blood plasma preservation. Established plasma freeze storage period is approx. 3 months but no scientific background exists to justify such a limitation of storage period.Considering EC as of paramount processing importance, the aim of the experiment was to determine the influence of plasma long-term freeze storage on this functional parameter.

MATERIALS AND METHODS

The experimental material consisted of 5 batches,each of 5L,of swine blood plasma processed in commercial conditions.Three 1L portions of plasma in plastic bags were immediately frozen in laboratory freezer at -18°C and stored at -18°C for 3 months.Emulsifying capacity /EC/ was determined basically according to Swift's method for both freshly processed and thawed at 4°C for 24h blood plasma freeze stored for 30,60 and 90 days/d/, respectively. Influence of NaCl added to plasma prior to EC determination /conc.:0.9, 1.5,2.0,2.5 and 5.0 percent/ and 2 sorts of fat/rapeseed oil and lard/ on EC was investigated. Changes in content of protein,dry matter and pH was also determined for fresh and stored plasma.

RESULTS AND DISCUSSION

Using rapeseed oil the highest value of EC was determined for plasma stored for 60d i.e 45.6 and 48.4ml/100mg protein and NaCl 1.5 and 5.0% concentration,respectively.For the same NaCl conc. as above smaller EC values i.e. 44.5 and 46.5ml/100mg protein were determined when lard was used for emulsification.An average EC for both sorts of fats and 5 NaCl concentrations for 60d stored plasma was 46.1ml of fat.No substantial difference in EC was observed for plasma stored for 90d in comparison to 60d.EC for freshly processed plasma,determined in conditions as above,was the smallest.For rapeseed oil and lard with 1.5 and 5.0% NaCl it was:41.5 and 45.4;40.1 and 43.1ml/100mg protein,respectively,being in average 42.3ml of fat. The difference in EC for fresh and 60d freeze stored plasma most probably resulted from alkalization as pH of plasma is highly correlated with EC./r=0.999/.It could be concluded that freeze storage of plasma for 60-90 days does not detrimentally influence plasma protein functional parameter such as emulsifying capacity.

6:13

UPGRADING AN UNDERUTILIZED PROTEIN SOURCE THROUGH FURTHER PROCESSING

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Spent layer meat is a cheap source of underutilized protein selling for ca 20 c per kilogram live weight.

Defeathered eviscerated spent layer birds were mechanically deboned without pregrinding and the deboned meat was used to prepare a all chicken frankfurters.The frankfurters were subjected to shear tests and compared to two well known commercial brand chicken frankfurters for overall acceptability by an untrained 59 member panel.

The spent layer frankfurters had greater resistance to shear than the two commercial brands. Most panelists commented that the spent layer frankfurters were tougher and that they preferred the commercial brand frankfurters. However, the spent layer frankfurters were not found unacceptable.

Collagen content for the spent layer franks was not higher than in the commercial franks. It is possible the toughness could have been due to the nature of the myofibrillar proteins.

Tenderizing enzymes can reduce toughness in meat when administered pre- or post slaughter. This could be a way of tenderizing the spent layer frankfurters and enable tailor making the texture to suit various palates.

6:14

MEAT RAW MATERIALS IN COMMINUTED MEAT SYSTEMS

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Even if considerable amount of work has been made with regard to the effect of processing in comminuted meat products, there is still a lack of knowledge with regard to the contribution of various meat raw materials to the structure and functional properties of comminuted meat products. Meat raw materials with exactly the same pH and chemical composition can give rise to differences in cooking loss of more than 10% by weight when used in coarse and finely comminuted meat products.

Some of the differences in texture, fat- and waterbindning can be understood by evaluation of the microstructure. Muscle raw materials seem to differ in their ability to emulsify fat. Some muscles cannot emulsify the fat at all and the fat is predominantly found in fat cells and bigger fat pools, whereas the use of other muscles give rise to a high proportion of small fat droplets under the same processing conditions. Differences in the size distribution of fat particles can be quantitatively determined by image analysis. Fat raw materials can also behave quite differently during comminution and subsequent heat treatment. So far myofibrillar proteins have received most attention of the meat proteins with regard to functional properties of meat products. They are indisputably of importance and their function depends strongly on their structural state and the degree of decomposition of the muscle tissue into fibers, myofibrils and dispersed protein. However, collagen when released from the muscle tissue during comminution and heat treatment seems to play a more important role to the structure and functional properties than hitherto acknowledged.

6:15

STUDIES ON SAUSAGE SUPPLEMENTED WITH SOY - SUNFLOWER PROTEINS

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ABSTRACT

Nutritive value of meat products blended with plant proteins is of essential consideration, since these proteins are limited in one or more amino acids . Soy - blended meat products containing up to 30% soy do not have significantly lower protein efficiency ratio than all-meat products . However, soybean protein is high in lysine and low in sulphur containing amino acids . On the other hand sunflower protein is poor in lysine and has enough content of sulphur containing amino acids. Accordingly , both proteins can complement each other.

It has been thought beneficial to process sausage with soy-sunflower protein isolate mixture and evaluate its quality and nutritive value . Sunflower-soy protein isolate mixture (containing 70% soybean and 30% sunflower protein isolates) was used to supplement sausage . Such a mixture was used at a level of 7.5% (with 3 parts of water to replace 30% of red meat). Organoleptic tests and consumer preferences were in favour of supplemented sausage with soy-sunflower protein isolate mixture plus sodium alginates . The nutritional value of sausage protein was not affected when compared with the FAO pattern, where calculated amino acid scores (A.S).Values were 1.0 or more . Grams consumed to cover the daily requirments of man in all essential amino acids were 196 gram for the control beef sausage,being less for supplemented sausage with plant protein isolate mixture (189 gram) and supplemented sausage plus alginate (193 gram) . Supplementation increased methionine plus cystine in 100 gram of sausage .

6:16

AN APPROACH TO ON-LINE AUTOMATIZED COOKING PROCESS OF WHOLE MEAT PRODUCTS

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The automation of cooking process of whole meat products is recently based on subjective methods. The result is often a product with unreliable quality. The defination of readiness of meat is not general and universal. The parameters cooking time and temperature disregard the different properties of meat. During the cooking process in the meat are going on complex chemical, biochemical and physical processes and their effect on the measurable properties is often counteracting each other.

Our problem has been to find a measuring method, which objectively signals the readiness of meat, and to automate this method. It is necessary to look for a measurable parameter, which correlates with sensory evaluation. Efficiency parameters (core temperature, mass loss) are represented in an exponential curve. They do not correlate with the sensory evaluation.
Rheological parameters show an oscillating curve during the cooking time. Important for the estimation of the readiness are characteristic parts in the curve.

A special consumer analysis has shown that the chewability and tenderness are the most important sensory factors for meat.

Chewability and tenderness correlate with rheological properties, for instance elasticity and hardness. The vibration measurement is a process measuring device, which measures the resonance frequency of meat in a non-destructive way during the cooking process in the oven. The resonance frequency correlates with the elasticity and changes in an oscillating way during the cooking time. In the characteristic part of this curve - the resonance frequency is constant - the meat was evaluated with the best sensory values. This is the point of readiness of meat and the cooking process is to be finished.

The characteristic part is independent of meat quality (PSE, normal, DFD), of cooking conditions and of cooking equipment.

The first step of automation of cooking process of whole meat products is gone, the readiness of meat can be measured by an objective method and the use of this method guarantees a meat product with the best reachable quality, related to raw meat quality, a minimum of energy consumption and a reduction of mass loss.

Next steps should lead to reliable industrial devices and to better knowledge on raw material preconditions for high product quality.

FOR SCHEDULE REASONS, REVISION NOT COMPLETED

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THE QUALITY OF COOKED SAUSAGE AS EFFECTED WITH THE MICROWAVE TEMPERING OF MEAT BLOCKS

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A meat thawing procedure influences significantly the quality of cooked sausages. Microwave tempering (thawing up to -3°C) allows to shorten the thawing time by 50-100 times, to prevent bacterial growth and to ensure meat high qualities.

For this study standard blocks of frozen boneless meat were used. Tempering was performed in microwave units of TPP-20 and AI-FDV types at 915 MHz and at 20 kW and 40 kW, respectively.

No weight losses during microwave tempering were observed, whereas in case of traditional air thawing (15°C, R.H. 90-95%) they reached 3%.

The properties of meat in blocks thawed traditionally or with microwaves were compared. Test samples had a more resilient consistency and a natural colour as compared to controls.

Protein denaturation changes, judging by the nature of their electrophoretic mobility, are less deep in case of microwave tempering. Differences in the chemical composition of test and control sausages (except moisture content) are insignificant. The water-holding capacity of test samples is 3-4% as high as compared to controls, the finished product yield is by 1.5-2.0% higher in case of microwave treatment.

The organoleptical qualities of test sausages are better: the consistency is more resilient, the cut surface colour is more intensive. Residual nitrite is 1.9% in test sausage as compared to 2.6% in controls.

Improvements in the sanitary-&-hygienic preparation of raw meat allowed to improve the microbiological condition of the finished product: the microbial load of the control sausages was 40% as high as compared to test ones.

Thus, microwave tempering allows to yield high-quality cooked sausages, helps reduce residual nitrite and extends the shelf-life of the finished product.

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A STUDY INTO THE INTERRELATION OF MOISTURE CONTENT AND ACOUSTICAL CHARACTERISTICS OF THE MUSCLE TISSUE

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Ultra-sound is finding new applications in food industries. Ultrasonic vibrations can intensify a number of technological processes, such as emulsifying, extraction and diffusion in the meat industry. When applying ultra-sound for measuring purposes, its capacity of propagating through any resilient medium, its low absorbability in liquid media and a possibility of its oriented radiation are utilized. All this allows to perform non-contact measurements. An advantage of ultrasonic control instruments is that they can be mounted directly inside the apparatus in the flow of the medium to be tested. Another advantage is continuous operation of ultrasonic devices.

Information on the application of ultra-sound to determine meat qualities is very scarce. Therefore, the authors performed tests which indicated that the values of ultra-sound propagation rate and attenuation coefficient in the muscle tissue depend only slightly on the structure (integrity) of the tissue and are mainly determined with its moisture content; that the relations of ultra-sound rate and attenuation coefficient in the muscle to the moisture content are non-linear. Analytical expressions describing these relations are derived. Besides, data are obtained on the connection of biochenical and ultrasonic parametres of muscle homogenates.

The investigations carried out resulted in the development of the procedure of sample preparation using ultrasonic homogenization.

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THE STADY OF THE CHANGE IN MOLECULAR-DYNAMIC CHARACTERISTICS OF MUSCULAR TISSUE IN STORAGE DEPENDING ON MEAT CHILLING CONDITIONS

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The aim of this study is investigating changes of molecular-dynamic characteristics in muscular tissue during the storage depending on meat chilling conditions.
As the object of investigation was chosen halftendon extracted from a beef carcass. Changes in meat during its processing and storage were estimated according to molecular-dynamic characteristics of muscular tissue. Here some considerations were followed. Considening muscular tissue as a net thine--dimensional system with chemical and fluctuating attachment nots it is possible to estimate mechanical-chemical processes in meat according to its molecular-dynamic characteristics in particular, to molecular mass of dynamic segments or to mass of one mole in the section between the nots of the structural net and also according to the number of segments in a volume unit and the number of segment moles in a volume unit. The nature of biopolymeric molecule packing is closely associated with their configuration. The latter can be estimated by outer mechanical field. Depending on interrelation of the field energy and the energy of activating rotation barrier highmolecular chains will be deformed to some extent.
Moneover, deformation propertias may serve as a measure of molecular configuration thus

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providing the particular packing and therefare as a measure of molecular mass.
It is focend that rapid cooling of meat up to temperature below 10°C results in two--phase change of molecular-dynamic characteristics which is connected with contracting of muscular fibres under the action of cold (CMFAC) and ducto development of stiffening. In using variable temperature conditions of cooling with mainteining meat at 12-15°C onephase change is observed which indicates the absence of CMFAC. The data obtained were applied in developing the method of meat processing confirmed by the autor's certificate.

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EFFECT OF FREEZING AND STORAGE ON SOME QUALITY PROPERTIES OF HEAT TREATED CHICKEN BREAST

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The effect of freezing and storage at -20 °C up to 18o days on the physical and sensory properties of fried chicken breast were investigated.Chicken breast weighing app. loo-15o g , 2 days post mortem, were used for investigations. The samples were treated by deep fat frying using maize germ oil at 175 °C until the temperature in the center of the breast reached 40 °, 60 ° and 80° C . Aluminium containers were used for the packing of semifinished (frying temperature in the center 40 ° and 60 °C) and ready--to-eat (temperature in the center 80 °C) samples .Before manually closing with aluminium foil , the samples were poured with maize germ oil , which was used for frying, then frozen at -20 °C and stored up to 180 days at the same temperature. The investigations of all samples,prepared as described were carried out after 4,60,90,100,110,120 and 180 days Before physical and sensory determinations were made all frozen samples were fried again as long as the temperature in the center reached 80 °C . Weight loss in % , tenderness (Werner-Bratzler apparatus) in kg , plasticity and elasticity (Höpler consistometer) in % were estimated to determine physical quality properties of chich chicken breast.Tenderness,juiciness,odour, taste and colour (on the surface) of the meat parts were sensory evaluated by the scoring of samples on a five point scale (from 1 to 5).On the basis of the results it can be concluded that there were no significant quality changes in all of samples, treated in three different ways during a storage period of up to 110 days.

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A POSSIBLE RELATION BETWEEN MUSCLE RESIDUAL GLYCOGEN AND YIELD OF MEAT PROCESSING BY CURING AND COOKING

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The aim of this study was to investigate a possible influence of muscle residual glycogen on the yield of meat processing (curing plus cooking). Twenty-eight rats were randomly assigned to 4 experimental groups (7 rats each). The animals were sacrificed after different combinations of diet and exercise, using Imalgene^{R} anaesthesia followed by iodoacetate injection or severing of the spinal cord. This experimental scheme allowed to get very variable residual glycogen levels (means of groups: 4.9 to 28.9) and ultimate pH (means of groups: 6.09 to 7.17). The day following slaughter, the hind legs were separated. Muscle tissue was carefully dissected from one leg, ground and used for determination of pH, glycogen, glucose, protein and water. The other leg was put into a 15 % (w/w) NaCl solution for 2 days, then cooked in 15 % NaCl for 2.5 hours using a waterbath (final temperature: 70°C). Curing yield, cooking yield and "technological" yield (weight after cooking/weight before curing) were determined. The results showed a negative relationship ($r = -0.6$) between the glycogen level and the "technological" yield ;the latter was better correlated with the glycogen level than with any other measured parameter.

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THE EFFECT OF LOW SALT CONTENT AND LOW pH VALUE ON THE WATER BINDING CAPACITY OF COOKED SAUSAGE

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The objective of this study was to determine the effect of low salt content and/or low pH value on the water binding capacity (WBC) of cooked sausage. Prevention of the decline of the WBC and structure was attempted by replacing part of the meat with isolated soy protein (ISP).

The WBC was studied using laboratory scale sized sausages with various recipes. The salt contents of the sausages used were 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 % sodium chloride. The pH values of the sausages were adjusted to 6.1, 5.8, 5.5 or 5.2. The ISP contents of the sausages used were 0.0, 2.0 and 4.0 %. Meat was replaced with ISP-water -mixture (1:3). The protein content and fat content of the sausages were kept constant. The WBC was calculated on the basis of meat or corresponding meat and ISP-water -mixture content, respectively. The recipes for the sausages contained no added phosphate, other recipes were used for those containing added phosphate. All variables (144 different) were made in random order and three replicates were made of each.

The WBC of the cooked sausage is strongly influenced by salt content and pH value. The WBC decreased when pH value, salt content or both were decreased in the sausages. The WBC was low if the pH value of the sausages was 5.5 or 5.2, with or without added phosphate, in spite of high or low salt content. In sausages with pH values of 5.8 and 6.1 the salt content could be decreased to 1.4 % with added phosphate. In the sausages made without added phosphate it could be decreased to 1.6 %.

If the salt content and pH value of the sausages were decreased, the replacement of meat by ISP did not improve the WBC and structure of the sausages compared to all-meat sausages. At high pH values and high salt content the replacement of meat by ISP did not change the WBC of the sausages compared to all-meat sausages.

At high pH values the salt content is not as essential as it is at low pH values. The salt content can be decreased, if the pH value of the sausages is high, without severely affecting the WBC.