

9. Nutrition, Residues and Health

Effect of Adding Inorganic Selenium and Vitamin E on the Growth and Status of Lambs in Regions Containing Toxic Concentrations of Copper in Fodder

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The influence of selenium concentration on the growth, health status and mortality of lambs bred in regions characterized by high copper content in food (25 ppm) has been investigated. The carry-over effect when using appropriate indicative organs has been studied. The initial and final Se-, Cu- and Zn-status of supplemented and unsupplemented animals has been analyzed by AAS-HS and AAS. Wet-dry ashing has been used with addition of magnesium nitrate for Se determination.

Increased amounts of Cu in food had a negative influence on average daily gain (g/day) of the lambs during the experiment (103 days). The animals fed with low levels of Se exhibited symptoms of Cu toxicity after the 30-th day. Significant higher mortality up to the 60-th day has been observed with the unsupplemented lambs.

The addition of selenium had a positive effect on the normalization of the Se-status and decreased significantly ($p < 0.001$) the accumulation of Cu in the liver. The evolution of Se and Cu in blood serum has been used as an indicator for the animal status. It can be concluded that toxic amounts of Cu destroy the Zn-status too. A significant reduction of Zn content in the ribs and liver has been measured.

Copper concentration in food of the order of 25 mg/kg required a 2.5-3 times increasing of selenium. Nevertheless, the observable growth depression indicates that Zn compensation is also necessary.

Histological Study of Liver and Kidneys in Lambs fed on Clenbuterol

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The effect of clenbuterol on the histostructures has been studied in both liver and kidneys of lambs fed high-concentratedly (6,0 MJ energy and 200 g/kg protein) for 42 days after weaning. Clenbuterol amount was 10 mg per kg of complete diet/mixture/.

Samples for histological analyses were taken on 42th day, on completing the trial, as well as one week after stopping the clenbuterol.

As a result of this study, stagnation and dystrophic effects have been established in liver, influencing negatively on the normal function of this organ. Changes in kidneys of animals tested occurred mainly in Malpighian corpuscles. Diversity in changing degree for extracapillary and intracapillary level of glomerules, on the one hand, as well as different affecting of all Malpighian corpuscles, on the other hand, determine the effect of clenbuterol in process of development. A week after stopping clenbuterol consumption, described changes have been observing in both liver and kidneys for single animals to a major or less degree.

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Changes which came at the process of copper and zinc accumulation in indicative plants depending on it's kind, stage of vegetation, remoteness from emission source compared with unpolluted region has been investigated. Dependences between copper and zinc content in fodder and in indicative animal organs from the same regions has been analyzed too.

All indicative plants in polluted regions accumulated 2-6 times more copper then these in unpolluted region. The difference of alfalfa measurements was high significant - 6.61 times. There was analogical tendency shown in lower grade (1.5-2.5) for zinc accumulation.

The copper and zinc concentration decreased on the soils with the same geological origin when first the stage of vegetation of pasture grass advance - 2.5 times and second, between first and third mowing of alfalfa.

When the copper concentration in fodder increased (depending on remoteness from emission source) then the Cu content in the sheep's liver increased too. Over the critical level (20 ppm copper in fodder) began sharp accumulation in the liver, manifested by chronic Cu poisoning symptoms.

When the copper was over the critical level in fodder it depressed the zinc resorbtion and it's accumulation in the liver.

Nutrition, Residues and Health

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Meat consumption is strongly suspected of being a risk factor in human nutrition. This hypothesis is based on different independent factors. First, prospective epidemiological studies provided evidence that a high intake of animal fat increases the risk of colon cancer. Colon cancer is amongst the most prominent health risk factors and ranks in the second position of oncogenic diseases reducing life span expectations in males and females. The relative risk of colon cancer seems to be associated predominantly with the consumption of red meat and animal fat. The second hypothesis is that the cause of cancer is related to certain compounds occurring in processed meats. It could be demonstrated that smoked, fried and cooked meats contain strongly mutagenic compounds belonging to a structural diverse group of quinoxalines. Quinoxalines and other mutagenic aromatic amines constitute during protein pyrolysis and they are generated not only in heated meat but also in other protein-rich foods i.e. fish and soybean products. However, in addition to the formation of mutagenic agents desmutagenic factors, e.g. α -dicarbonyl and α -hydroxycarbonyl compounds, have been described to occur in processed meat. Together with recent findings demonstrating a limited absorption of aromatic amines and their sensitivity to metabolic degradation, these data contribute to the uncertainty in evaluating the real significance of single component effects to the overall risk in humans. As a third group of compounds considered to contribute to a health risk related to meat consumption residues of environmental pollutants as well as veterinary drug residues have to be mentioned. The abundance of a variety of chemicals in the environment being able to form residues in edible tissues of farm animals and the frequent use of growth promoters as well as therapeutic agents in animal husbandry has resulted in a disbelief about the safety of animal derived foods. It seems necessary to encourage a comparative assessment of the risk generated by natural occurring unavoidable environmental factors and compounds introduced intentionally into the food production process. Such an approach has to include the principle pharmacological/toxicological effects of certain drugs or pollutants, their kinetic profile and biotransformation in the target animal species in relation to the formation of toxic metabolites. For the majority of industrially synthesized compounds the available information meets the demands of a scientific risk assessment. In contrast, natural occurring toxins and traditional food additives have been investigated with less intensity resulting in an incomplete assessment of their toxic potential for the consumer.

Transfer of Radiocesium from Plants to Venison

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The spatial distribution of the fallout of radiocesium caused by the reactor accident of Chernobyl was contrary to that of the nuclear-weapon experiments of the fifties and the early sixties very inhomogeneous caused mainly by the different trajectories of the radioactive clouds and the various amounts of rainfall. The cesium in the atmosphere was washed out to the leaves and needles by rain and airflows, and deposited on the soil. The uptake of radiocesium by plants was influenced by several specific plant parameters. Differences in the contamination rate occurred among the species (respectively genera and classes). Thus shrubs and trees are less contaminated than ferns and most of the fungi species. The highest contamination of radiocesium occurred in forest ecosystems, mainly in coniferous woods. The radioactivity of the plants growing on agricultural areas lied often near the detection limits. Subsequently venison of game living on agricultural areas was and is less contaminated than that of animals living exclusively in coniferous forests.

The plant composition of the browse depends on animal species. The contamination of game differs with regard to its habits of food selection. By far wild boars contain the highest amounts of cesium of all game species investigated, living in the same biotopes, followed by roe deer. The lowest content is found in red deer. Roe deer is a feed selector, choosing special plants. They also like to nibble the buds and tips of twigs and young plants. Red deer has an intermediate position among the feed selectors and grass-eaters. In opposition to wild boar is an omnivorous animal which likes to root in the soil. Soil is the highest contaminated part of a biotope because the radiocesium is accumulating there. The litter-layer of the soil contains most of the radiocesium caused by its high exchange capacity and the slow vertical migration of the cesium. Wild boars take up litter and mineral particles from the soil by rooting and eating worms, beechnuts, snails and mushrooms. Its higher radiocesium contamination is caused by this uptake, especially by fungi and soil components.

Monascus-Extract a Possible Alternative to Nitrite in Meats

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The use of nitrite (nitrite curing salt) or nitrate (salpetre) for the curing of meat products has a long tradition and provokes little health risk in the amounts legal in Germany. Nevertheless, alternatives are of interest. In Asia the mould *Monascus purpureus* is traditionally used to colour and flavour different foods, and this mould is believed to be beneficial for the health of the consumer too.

Our work with *M. purpureus* (DSM 1379) revealed that the extract of this mould grown on rice is non-toxic, improves the colour formation and especially the colour stability of frankfurter type sausage as well as fermented sausage, has at the recommendable level of 4000 ppm a bacteriostatic effect on some undesirable bacteria in meats, and influences favourably the lipids in the blood of rats.

Thus, Monascus-extract may be regarded as a possible alternative to nitrite. However, it probably will not replace in general the use of nitrite for meats, but could provide health conscious consumers attractive meat products without curing agents. If Monascus-extract is used in combination with nitrite, the nitrite addition to meat products could be decreased considerably.

Skatole levels in pigs selected on high and low protein dietsK. LUNDSTRÖM¹, B. MALMFORS¹, S. STERN¹, L. RYDHMER¹, A.B. MORTENSEN² AND H.P. MORTENSEN²¹Dept. of Animal Breeding and Genetics, Swedish University of Agricultural Sciences, S-750 07 Uppsala, Sweden; ²Danish Meat Research Institute, P.O. Box 57, DK-4000 Roskilde, Denmark

A selection experiment with purebred halothane negative Yorkshire pigs was conducted at the Swedish University of Agricultural Sciences. The pigs were fed either a high (18.5% crude protein, 0.96% lysine) or a low (13.1% crude protein, 0.64% lysine) protein diet. Both selection lines had the same breeding goal, i.e. high lean tissue growth rate. The pigs included in the present study (164 entire males, 91 females) were from generations 1 and 4 in the selection experiment. Back fat samples were taken after slaughter (approximately 100 kg live weight) from the shoulder region, and analysed for skatole content. The model used in the statistical analyses included the effect of generation, selection line, dam, and the line by sex interaction.

The males from the low protein line had significantly higher skatole levels ($p \leq 0.001$) compared with males fed the high protein diet or females fed the low protein diet. No difference was found between males and females on the high protein diet. Only 2.8% of the males in the high protein line were above the threshold value suggested for skatole (≥ 0.20 ppm), while 22.8% of the males in the low protein line were above this value. No females exceeded the threshold.

In an earlier study, we found a positive influence of fibre content in the diet on skatole concentration. It should be noted that it was the entire male pigs fed the low protein diet in the present study that had higher skatole concentrations in the back fat. The low protein diet, as well as the diet in the earlier study, had a high content of yellow peas (10%). This type of pea has a high content of oligosaccharides, i.e. sugars that are not very digestible by the pig. The starch in yellow peas has also been shown to be less digestible than starch from e.g. barley. Both these factors might cause increased fermentation in the colon, which probably increases the risk of a high skatole production. It still remains to be proved that the increased skatole levels found here is a specific effect of yellow peas.

Investigations into the occurrence of polycyclic aromatic hydrocarbons (PAH) in feed and in farm animals

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The results of the investigation were obtained from 2 fields exposed to different loads. Field 1 (Hoyerswerda area/Saxony) was characterized by pollution emitted from lignite power stations, gasworks and other industrial plants. Field 2 (Waren-Müritz area/Mecklenburg) did not show any significant emission except that caused by stove heating and traffic.

Feed from both fields (maize, alfalfa, grass, straw, hay, grain, silage and drinking water) was examined for the presence of 3,4-benzo(a)pyrene. Tests were carried out according to the method developed by STOYKE et al. (1990)*. Samples with a concentration exceeding 1 µg 3,4-benzo(a)pyrene per kg were tested for other PAHs. PAH concentrations were determined in the spinal fat and in the brain tissues of farm animals (pigs and cattle).

The farm animals were mainly given feed and water which had been examined for PAH.

The test results were evaluated for the effect of PAH on the farm animals and a study made of possible effects on consumers of animal products. The PAH concentrations in feed exceeded those in the animals.

* STOYKE, M., HENKE, G. and MÜLLER, L. (1990): "Untersuchungen zur Analytik von PAH in ausgewählten tierischen Organen. Investigations into the analytics of PAH in selected animals organs; Paper delivered at the 31st working session of the group food hygiene of the German Veterinary Society (DVG), October 2 to October 5, 1990 in Garmisch-Partenkirchen.

Research on Goose Meat and its Product Development.

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This paper was brought up to meet with the need of rapid development of the goose raising industry in China. Most Chinese people, except those living in national minority regions, have been taking pork as their major source of meat supply. Grain output in China will reach to 400 kilograms per capita by the end of the century, therefore, it is unlikely for China to pour more grain into the grain-to-meat conversion process given its huge population size. On the other hand, the average protein ingestive amount for the Chinese people, particularly the animal protein, is much lower than the world average level. Thus, developing grain-saving livestock and poultry has become important to the Chinese people. Unfortunately there has been very little report about goose raising in China, either on theoretical study or on its utilization and development. Further more, people in the northeast region of China dislike goose meat, thinking it be fish smelling and fiber texture coarse. This study was carried out in attempt to deal with such considerations.

By means of electron microscope analysis, we studied goose meat microstructure, its components by using amino acid analyzer, gas chromatography and atomic absorption spectrophotometry. The results indicate that goose myofibrils is rather thin, sarcomere is shorter, meat is tender. It is the excellent whole protein that forms the goose meat protein. Goose fat possesses rich unsaturated fat acid that is much better than the other's. The nutrient value of goose meat is higher, the mashed goose bone contains a great deal of protein and mineral materials. It can be used as an ideal nutrient enhancer.

The optimum proportion of the de-smelling agent was obtained by means of Scheffe Statistics, which is composed of B-circle dextrin and the other ingredients. The quality conditioner which could improve water holding capacity of goose meat was chosen and formulated using the orthogonal test. Various of quality goose meat products have been developed with application of the research results, such as goose pumping ham, mashed bone sausages and goose meat sausages, to list only a few.

Effect of Dietary Fat quality and α -tocopherol supplementation on the susceptibility of porcine tissue to lipid peroxidation.

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Experiments were designed to investigate the effects of oxidized soya oil and α -tocopherol supplementation on fatty acid composition, α -tocopherol concentrations and on thiobarbituric acid-reacting (TBARS) in porcine muscle and tissues. Thirty-two pigs of approximately 45 kg liveweight were fed a diet containing 3% fresh soya-oil or 3% oxidized soya oil (P.V. \approx 100 meq O₂/kg oil) with either a basal (10 mg/kg diet) or supplemented (200 mg/kg diet) level of α -tocopheryl acetate. The pigs were slaughtered when they weighed in excess of 85 kg.

In pigs fed the oxidized soya oil diet the polar lipid fractions of muscle and other tissues had lower C18:2/C18:1 ratios when compared to pigs fed the fresh soya oil.

Muscle from pigs fed the oxidized soya oil diet was significantly more susceptible to lipid oxidation than that from pigs fed fresh soya oil. α -Tocopherol supplementation increased the oxidative stability of muscle and other tissues in pigs fed oxidized or unoxidized oils.

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Two major mechanisms are proposed to explain formation of meat mutagens. The Maillard reaction, which involves Amadori rearrangement as a key step, results in sugar fragmentation and free radical formation. We propose that the imidazoquinoline meat mutagens (2-amino-3-methylimidazo[4,5-f]quinoline or IQ and 2-amino-3,4-dimethylimidazo[4,5-f]quinoline or MeIQ) are formed from a reaction mixture containing alkylpyridine free radicals and creatine/creatinine. We further propose that the imidazoquinoxaline meat mutagens (2-amino-3,8-dimethylimidazo[4,5-f]quinoxaline or DiMeIQx and 2-amino-3,4,8-trimethylimidazo[4,5-f]quinoxaline or 4,8-DiMeIQx) are produced through reacting a mixture of dialkylpyrazine free radicals with creatine/creatinine. Two probable pathways for formation of free radicals are proposed. One involves bimolecular ring formation the enaminol form of the glycoaldehyde alkylimine, which is followed by oxidative formation of the free radical. The other pathway suggested takes place through formation of N,N,N¹-dialkylpyrazinium ions from glyoxal monoalkylimine followed by reduction to produce free radicals. The intermediates could be formed by reacting glycoaldehyde and glyoxal with amino compounds. The glycoldehyde system reacts faster and produces more free radicals than the glyoxal pathway and explains the predominance of imidazoquinoxaline mutagens over the imidazoquinoline mutagens in fried meat and fish. BHT has been shown to increase mutagen formation by splitting off a methyl group, which reacts with alkylpyrazine free radicals and creatinine to form 4,8-DiMeIQx. BHA, PG and TBHQ inhibit mutagenicity since they contain methoxy groups that become quinone-like compounds that serve as potent free radical scavengers and block formation of meat mutagen precursors. Tocopherols and sulfites also block mutagen formation by preventing the Maillard reaction and production of free radicals. Understanding the mechanisms involved in the formation and blocking of meat mutagens should prove helpful in eliminating them from cooked meat products.

Effect of Gamma-Radiation on the Hydrophilic Properties of Meat from Radiated Lambs

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Hydrophilic properties are among the factors which determine meat quality.

The subject of the present study is the effect of 3.3 Gy gamma-radiation on the amount of free water, water-holding and salt-holding capacities of meat from radiated animals. The method of Grau and Hamm, based on the combination of the pressmethod and filter paper method, has been used. It has been established that 3.3 Gy gamma-radiation of lambs causes certain changes in the progress of postmortal phenomena in meat by precipitating of rigor mortis as compared to the controls. This effect is related to the reduction of the hydrophilic properties of meat where the maximum level of free water was reached on the 24 (20.64 %) while the meat from nonradiated animals reached that maximum on the 36 h (17.75 %). The results for the water-holding capacity of meat from radiated animals indicate that the minimum levels were reached earlier, on the 24 h (4.43 %), compared to nonradiated (36 h, 7.53 %). Similar is the tendency in the changes of the salt-holding capacity. The latter is the highest during the first hours post mortem, and decreases after that both in control and test samples. A faster decrease of the salt-holding capacity has been noticed in meat from 3.3 Gy gamma-radiated lambs with minimum levels on the 24 h (4.58 %). In nonradiated samples this minimum is on the 36 h post mortem (7.61 %).

Results of a Monitoring Study: Contamination of Pork from the Western States of the Federal Republic of Germany with Harmful Substances from the Environment

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In 1989/90 a monitoring study with pork in the western states of the Federal Republic of Germany was carried out about the occurrence and concentration of radiocaesium, heavy metals, organochlorine pesticides (OCP) and polychlorinated biphenyls (PCB). All samples were chosen at random in butcher shops of a big supermarket chain. Samples of muscle were analyzed for radiocaesium, samples of muscles, liver and kidneys for lead and cadmium, and samples of fat and liver for OCP and PCB.

Because of their toxicity and accumulation within food chains, Germany has established recommended values (Richtwerte) for heavy metals and threshold values (Grenzwerte) for OCP and PCB. No legal regulation exists at present for radiocaesium in foods and feeds produced within the EEC. Residues of the 12 OCP and 4 PCB investigated are commonly detected in liver and fat of pigs, generally at levels that are one to two orders of magnitude below the legal threshold values. The concentration of radiocaesium in muscles did never exceed 100 Bq/kg. Whereas the contamination of liver with lead and cadmium rarely exceeds the recommended values and also the contamination of kidneys with lead remains low, the cadmium concentrations in kidneys often exceed the recommended values.

However, according to our results, it is reasonable to assume that the amounts of radiocaesium, heavy metals, OCP and PCB present in pork in Germany do not make a major contribution to the overall uptake of these substances in our food.

Influence of Vegetable Oils and α -Tocopherol Supplementation on Lipid Peroxidation in Chick Muscle

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It has been suggested that peroxidized fats accelerate turnover of α -tocopherol (α -T) in the body and promote lipid oxidation *in vivo*. The effects of feeding heated fats high in polyunsaturated fatty acids on the levels of α -T, TBA-Reactive Substances (TBARS) and fatty acid composition in chicken muscle were studied.

Sunflower and linseed oil were heated @ 140°C x 24 h with constant aeration. 48 one-day old chicks were randomized into 6 groups, and fed diets containing either fresh sunflower oil (FSO), fresh linseed oil (FLO), heated sunflower oil (HSO), heated linseed oil (HLO), α -tocopheryl acetate (α -TA) supplemented heated sunflower oil (HSE) or α -TA supplemented heated linseed oil (HLE). Diets contained 0.005% BHT and 50 mg α -T/kg except for HSO and HLO which were devoid of α -T.

Chicks fed HSO and HSE had normal growth, but growth was depressed by feeding HLO and HLE. Plasma α -T was a good indicator of α -T concentration in white and dark muscle. Concentrations of α -T in plasma and white muscle of chicks fed FSO were significantly greater than in those fed FLO. α -T levels in plasma and muscle were reduced by consumption of heated, or heated supplemented oils, the depression being greater in chicks fed sunflower oil.

TBARS increased significantly in plasma, white and dark muscle of chicks fed HSO and HSE compared to those fed FSO. The effects on chicks fed HLO or HLE were less pronounced. Muscle lipids from chicks fed linseed oils were more susceptible to stimulated peroxidation than those from chicks fed sunflower oils. Fatty acid profiles reflected those of the dietary lipids. The results show that supplementation of heated oil diets with α -TA does not result in optimum storage of α -T by muscle. The tissue is thus predisposed to oxidative deterioration.

Fungal Growth and Appearance of Aflatoxins and Ochratoxin A in Dry Sausage

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The objective of present study was to examine contamination of "tea sausage", a type of Yugoslav dry sausage, with moulds, aflatoxins B₁, B₂, G₁ and G₂ and ochratoxin A.

All the samples tested (30) originated from market.

Determination of total viable counts of moulds per cm² of sausage surface, as well as their isolation, were performed by using the standard Koch's method. Sabouraud dextrose agar with streptomycin (0.01 - 0.02 %) was used as an isolation medium. Incubation was carried out at 25 °C for five to seven days.

Identification of aflatoxins and ochratoxin A was performed by using a modified method described by Balzer et al. (1978).

About 87 % "tea sausage" samples were found to be contaminated with moulds (0.5 to 1.6 x 10⁴/ cm²). Isolated mould strains were classified into 4 genera and 15 species as follows: Alternaria alternata, Aspergillus repens, A. sydowi, A. terreus, Cladosporium cladosporioides, C. herbarum, C. variabile, Penicillium adametzi, P. brevi-compactum, P. chrysogenum, P. claviforme, P. commune, P. griseofulvum, P. notatum and P. verrucosum var. cyclopium.

Cladosporium spp. and Penicillium spp. were the most frequent moulds. They were isolated from 62 and 54 % samples tested, respectively.

Aflatoxins B₁, B₂, G₁ and G₂ did not establish in "tea sausage" samples. But, 3 samples were contaminated with ochratoxin A at concentration of 40.0 µg/kg.

Separation of porcine blood. Use of the red cell fraction in meat products and preparation of blood platelets

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From animal blood different cellular fractions may be separated. The aim of the present study was to describe how the red cell fraction can be used as a colour component and a heme iron source in meat products, and how large amount of porcine blood platelets may be prepared.

Iron deficiency is by far the most common nutritional disorder and cause of anemia in industrialized countries. As the availability of heme iron is recorded to be 3-10 times that of non-heme iron, it should be of interest to increase the amount of heme iron in our diets. To achieve this, determination of total heme, hemoglobin and myoglobin is necessary. Hemoglobin and myoglobin have been quantified by HPLC using a Bio-Gel Phenyl-5-PW column. By the use of blood it is possible to increase the amount of heme iron in meat products and to optimize the red colour.

Blood platelets contain a number of growth factors that stimulate cells in tissue culture and are effective in wound healing. By using biocompatible materials and continuous flow centrifugation kilogram quantities of porcine blood platelets have been prepared. Thrombin releasate of the platelets stimulates cells in tissue culture.

Studies On Technology Research For Production Of Meat Items With Radioprotective Properties

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The problem of ecological balance disturbance as a result from environment radioactive pollution proves the necessity for development of specialized food products that may be used for a long time without having any additional effect on human organism.

The lack of studies dealing with this problem shows the absence of general theoretical approach towards the situation and valid rational nutrition, which would be able both to increase organism radioresistance and to have definite therapeutical effect.

The possibility for developemnt of meat products with radioprotective properties is examined. Six types of sausages are developed. In definite quantities are added the following substances: wheat germ, pectin, potassium chloride, fluorine water and microbial starter culture - "Biostart".

Biological experiments with these items are carried out on rats and mice in order to establish their decorporative and radioprotective effect.

The experiments are conducted on 280 male rats and 110 male mice - hybrides, as the animal number is determined regarding the experimental setting.

The animals are irradiated outside by X-rays and inside - with strontium - 85 which is in the form of strontium chloride and cesium - 134.

The decorporative effect is assessed on the data from the measured whole body activity and radioactivity of critical organ (femur) or spleen and liver.

Haemopoetic effect is examined in founder cells and peripheral blood.

The results shoe that the food items, prepared with starter cultures, have protective action towards strontium and cesium radionuclei. The microbial starter cultures show most expressed radioprotective and decorporative effect - till 47%.

Effect of Gamma-Radiation on the Structural and Mechanical Properties of Pork

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Feeding of population in an environment of elevated radioactivity necessitates utilization of meat from farm animals radiated with ionizing radiation. In this connection, it is worthwhile to know the changes in the technological properties of meat from radiated animals.

The present study treats the structural and plastic strength and elasticity of pork obtained from animals following 2.2 and 3.3 Gy gamma-radiation, using the method of penetration. The results indicats that the elasticity of pork from 3.3 Gy gamma-radiated animals decreases more rapidly, and the minimum level was reached on the 24 h (63.59 %). The meat from 2.2 Gy radiated and nonradiated animals has the same minimum levels on the 36 h post portem (67.08 and 69.54 %, respectively). The structural strength of meat from 3.3 Gy radiated pigs stayed high throughout the whole test period until the 72 h reaching its maximum on the 24 h (133.04 kPa) as compared to controls and meat from 2.2 Gy radiated animals (36 h - 122.19 kPa, 36 h - 126.15 kPa, respectively). Similar tendency has been established in meat plastic strength studies. The levels in meat from 3.3 Gy radiated animals are high during the whole test period with the maximum registered on the 24 h (40.96 kPa). In 2.2 Gy radiated meat the maximum was on the 36 h (38.21 kPa). The results obtained indicate that gamma-radiation of animals with 3.3 Gy accelerates the postmortal processes resulting, in more rapid advent of rigor mortis.

Fish Meat Chemical Element Composition and Its Changes during Technological Processes

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The red and white muscles of sea and fresh water fish of the Volga-Caspian basin, Aral and Balkhash lake were studied. About 90 per cent of the world stock of sturgeon-type fish are concentrated in these areas. Organs and tissues of sturgeon, white sturgeon, sevruga, sterlet, caspian herring, soodak, sazan, bream, white and motley tolstobic, white amour, carp and perch were investigated in the seasonal aspect in various periods of their life. The antagonistic and synergetic ties and relationships between different methods and enzymes were considered. The specific peculiarities of protein accumulation, common lipids protein fractions, cholesterol, triglycerides and fatty acids in fish meat have been determined. The dynamics of microelements and various lipids in the process of salting, smoking, curing fish meat as well as in the process of different methods of salting sturgeon type fish spawn was observed. Our results may be taken into account in different technological processes of fish treatment including the manufacture of canned fish meat, of fish flour for feeding domestic animals and the manufacture of high quality animal protein.

Studies on a New Canned Food Composed of Plants and Meat

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Processing of canned food product made from local plant and meat resources, according to the physicochemical and biological properties of the plant and minced meat, is the objective of this study. The studied product is a multiplex canned food. It is the first generation of a high grade, natural, nutritious canned food in China. It is rich in the nutritive composition and eatable fiber. Protein, fat, moisture, vitamin C, vitamin A, vitamin E, β -carotene and glucomannan were 12-15%, 15-20%, 50-55%, 1-5mg/100g, 8-10 μ g/g, 0.1-0.15mg/100g and 0.2-0.4g/100g, respectively. It contains many kinds of trace elements and eighteen kinds of amino acid, as well as preservatives and artificial synthetic pigments. It shows the special advantages of both animal and plant components.

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The Use of Edible Fibers as Carriers of Essential Oils of Spices for Sausage Items

Manufacture

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At present spicy flavourings are created and introduced into sausages using salt, sugar, red pepper and other substances as carriers of essential oils.

The possibility of use of microcrystalline cellulose (MCC) and methylcellulose (MC) as carriers of spicy essential oils was studied.

Essential oils and their compositions were dispersed on MCC and MC by spraying of oils in a rotatable drum.

Resulted flavourings were dry granular powders with specific pure aroma, intensiveness of which didn't alter during storage.

The Study of Meat Products Flavourings Developed on the Basis of Spicy Essential Oils and

Meat Flavour Based on Maillard Reaction

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Using physico-chemical, spectral and organoleptical methods research was done aimed at development of complex flavourings (CF), ensuring intensification of meat and spicy aroma.

The use of CF for sausages made possible to exclude from formulations mixes of dry traditional spices and ensure well-expressed aroma and taste of products. It was established that CF contribute to development and stabilization of cooked sausages colour.

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Mechanico-Structural Analysis of Different Types of Meat during Storage and Heat Treatment

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The aim of the present work was analysis of changes, taking place in muscle tissue of beef, pork and mutton during cold storage and heat treatment.

Changes of meat consistency in process of cold storage and heat treatment were evaluated by rheological characteristics determined by quasistatic method.

The character of change of rheological characteristics of beef, mutton and pork in process of chilling and subsequent heat treatment was established. Correlation regression analysis of research data was performed, which made possible to propose equation of regression, characterizing correlation between rheological characteristics and time of cold storage and heat treatment.

3

The Influence of Freezing and Further Defrosting on the Process of Heat Denaturation of Myofibrillar Proteins of PSE Pork

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In the present work structural change of myofibrillar proteins and their water-holding ability in PSE ($pH_1=5.4$) and normal pork ($pH_1=6.15$) in process of heat denaturation and on the background of meat ageing from 2-3 to 96 hours post mortem, were studied, using methods of native protein fluorescence. Investigations were conducted on chilled and defrosted meat.

It was shown that contrary to traditional pork with normal pH-value, freezing and further defrosting positively influence PSE meat, stabilizing structure of myofibrillar proteins and increasing water-binding ability during ageing time, exceeding 24 hours.

The Use of Complex Quality Criterion for Optimization of Meat Products Formulations

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Calculation method for development of optimal meat products formulations, based on integrational principle of linear programming and on method of complex quality evaluation, was proposed. This method includes: plotting of scales of desirable quality parameters; calculations of formulations on the basis of simplex-method; calculation and evaluation of quality indices of the product, not accounted during determination of limits; calculation of complex index of formulation; maximization of complex criterion through purposeful change of limitations of individual quality indices of product and/or ingredients.

Mechanics of Muscle Tissue Behavior During Massaging and Tumbling

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The aim of the present study was to investigate influence of mechanical treatment time on mechanical properties and structure of beef muscle tissue. Modelling of mechanical processes was performed on special stand based on universal testing machine "TIRATEST-2200" (Germany). It was established that mechanical treatment significantly changes mechanical properties of meat raw material. These changes are caused by destruction of muscle tissue structural formations. Character of changes differs, depending on meat structure and content of connective tissue.

Experimental methods were suggested for the study of mechanical treatment processes based on methods of polymer mechanics and hystological analysis.

The Influence of Polyphosphates Having Different Chemical Nature on the State of Structure of Myofibrillar Proteins and Collagen of Intramuscular Connective Tissue of PSE Pork
 Part 1. The Influence of Different Polyphosphates on Myofibrillar Proteins of PSE Pork
 Part 2. The Influence of Different Polyphosphates on Collagen of Intramuscular Connective Tissue of PSE Pork

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This paper gives results of study of three sodium polyphosphates influence (Curafos 700, Curafos II-2 and $\text{Na}_3\text{HP}_2\text{O}_7$) on the process of heat-induced denaturation of myofibrillar proteins of PSE pork during its ageing from 3 to 48 hours.

It was shown that the character of polyphosphatic influence on the process of heat denaturation of myofibrillar proteins of PSE meat is defined by chemical composition of these polyphosphates and by meat ageing time. Besides, it was shown that Curafos 700 improves myofibrillar structure of proteins of PSE pork during heating.

In process of study of sodium polyphosphoric salts influence on thermodynamic characteristics of heat-induced collagen denaturation of intramuscular connective tissue of PSE pork, this influence and its variability depending on type of polyphosphate were confirmed.

5

Quality Of Poultry Meat Boned In A Machine With An Elastic Working Part For Its Further Utilization In Sausage Production

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Introduction of machines for poultry carcasses mechanical boning allows to process non-standard carcasses and separate parts. Conducted experiments make it possible to develop requirements to machines design that allow to decrease the level of low grade boned meat from 28 to 16%. This will broaden the range of raw materials and as well as a result the assortment of poultry products.

To obtain ground meat with muscle tissue integrity there was used a machine with an elastic working part "Farsh-4-500". Such type of meat is the intermediate raw material between meat of manual boning and mechanical one because ground meat is better than mechanically deboned due to its content of fullvaluable protein. Combined use of the abovementioned meat types will lead to extension of sausage products assortment. For ground meat production there were studied rational parameters of the process and its functional properties.

Certain Aspects of Pork Quality

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Intensive modern technologies of growing and feeding of pigs, including breeds of high meat productivity, under conditions of large industrial complexes predetermine deviations in meat quality, negatively influencing consumer properties of finished products.

On the basis of research data it was established that factor of breed influences pork quality in a greater extent than growing and feeding technology.