

SESSION 9. PRODUCTION MANAGEMENT AND PROCESS CONTROL

9:1

CONTROL OF QUALITY AND PRODUCTION EFFICIENCY OF MEAT PRODUCTS

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During the last conference we reported on the mathematical considerations of the optimization of formulas and on the "back-track" type optimization of daily production in the meat industry. Although good results were achieved with this system efficiency has been limited by the unfavourable price structure of raw materials. So the correspondence between quality /functional characteristics/ and price /effective value/ is missing.

Consequently, we have decided to analyse the nature of raw materials taking into account their functional and sensory characteristics, their nutritional role and technological adaptability.

For this purpose we introduced the concept of "ideal" muscular, connective and fatty tissue. The raw materials are characterised by the type and frequency of the "ideal" tissue elements and by their size.

The quality and technological adaptability of raw materials should be expressed by the so called "effective value". Like basis of comparison we have chosen the dressed pig carcass with a score of 100.

The "effective value" of raw materials was estimated by a panel of experts. On the basis these preliminary data algorithms and a process of iteration have been used to calculate the "effective value".

Some "effective value" are the following:

cleaned, boneless loin	253	adipose tissue	29
boneless ham	201	rind	13
Meat, I. class	183	tendon	16
Meat, II. class	164	bone	4
Meat, III. class	141		

The above data help in the calculation of the "effective values" of the "ideal" tissue types. The latter serve for evaluation of different raw materials and calculation of prices. These considerations will be used in the control of production and quality with special regard to the production cost.

9:2

LEAN CONTENT EVALUATION IN PIG CARCASSES USING THE DANISH FAT-O-MEAT'ER

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The need to fulfil E.E.C. regulations on pig carcass grading, as well as the awareness of the peculiar characters of Italian pig production, has urged a critical assessment of the Danish FOM, one of the instruments most widely used for this purpose. A study was therefore carried out in which 200 pig carcasses were selected in a way to cover the most complete range of dead weights and lean meat contents available on the market.

The left sides of the chosen carcasses were probed for fat thickness and muscle depth at three locations (between the second and third, third and fourth, and fourth and fifth ribs posterior to the last rib) and at three positions (7, 9 and 11 cm off the dorsal mid-line). The lumbar region was also probed for fat thickness at two locations (between the third and fourth, and fourth and fifth vertebrae from the last one) and at two positions (8 and 10 cm off the dorsal mid-line). In addition the caliper of the FOM was used to measure fat thickness at three positions (on the middle of the gluteus medius muscle, at the last rib and at the shoulder) on the dorsal mid-line of the carcasses.

After overnight chilling, all pig sides were cut according to the "Parma" jointing method into four lean cuts (ham, loin, shoulder, neck) and three fat ones (bel-

ly, backfat, collar fat). For 126 of them each joint was subsequently separated into subcutaneous and intermuscular fat, bone and lean to define percentage of lean yield. Starting from such total dissection results, a partial dissection equation was fitted and applied to the remaining 74 pig sides. It was based on ham and belly dissection and was able to predict the lean content of the carcasses with a residual standard deviation of 0.8833 and a Rsqr. value of 0.9771. The range in warm carcass weight and percentage lean yield varied from 65.3 to 191.3 kg and from 33.06 to 61.46%, respectively. Using a stepwise procedure (maximum Rsqr. improvement technique), a comparison of multiple regression equations to predict lean yield (%) was carried out on the basis of the most interesting FOM measurements among those taken. The lowest residual standard deviation (1.9662) and the higher Rsqr. value (0.8946) were obtained combining fat thickness between the third and fourth last lumbar vertebra (10 cm off the dorsal mid-line) with fat thickness and muscle depth between the third and fourth last rib (11 cm off the dorsal mid-line). The equation has been proposed as FOM formula for Italy.

9:3

FACTORS INFLUENCING THE ECONOMY OF FATTY TISSUE /EFT/ -MODEL OF POLAND

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Economy of fat tissue /EFT/, a subsystem of economy of fat is related to other subsystems and (on another hand) to the meat economy. Unfavourable phenomena and a decrease of resources in the both food economies in Poland / 1981 - 1982 / caused a cumulated negative effect in the economy of fat tissue, fat balance problems and a demand increase. Due to limited resources the optimization of the fat tissue economy in the macroeconomic scale /national economy/ and in the microeconomic scale /meat plant/ is essential. Because of a great number of cells which manage fat tissue / with different management specificity/, complex approach and analysis of the problem with system methods is necessary.

In the present work the EFT model in a macroeconomic scale was constructed, technical indices of utilization and then material flows in the model were found. Also the EFT model was analysed in microeconomic scale, considering the necessity of meat processing operation in the meat plant.

These analysis allowed the determination of main factors influencing the EFT, such as : meat-fat raw materials resources and the production structure in the meat industry, balance of edible fats in the country, demand of feed industry, trends of fat utilization for technical purposes, and the model of fat consumption.

Main factors influencing rational fat tissue economy in microeconomic scale are : the kind and features of meat and not meat raw materials, the program and technology of production, the machine performance and workers qualifications. This determines a different approach to construction of control systems in the fat tissue economy in the macro- and microscale.

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AN OBJECTIVE BRUISE SCORING AND PENALTY SYSTEM FOR THE AUSTRALIAN BEEF CATTLE INDUSTRY

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INTRODUCTION

The causes, incidence and cost of bruising in Australia's beef cattle industry has been widely researched but so far the individual cattle producer perceives little incentive to guard against bruising and thus the problem has persisted. If, however, the basis of producer payment were to be changed to incorporate a penalty in the event of bruising (equivalent to a premium in the absence of bruising) an incentive would exist to implement those husbandry practices known to mitigate against bruising. The challenge to design a bruise sensitive payment system lies in several pre-conditions: (a) carcass trading (producer to processor) according to objective specification; (b) the scoring of bruises according to their location and severity; (c) valuing bruises relative to carcass weight and contingent economic loss; and (d) revealing to the producer the nature of any bruising on his cattle and how much it cost him.

METHOD AND DISCUSSION

Bruise scoring was confined to four primal cuts (silverside, full rump, striploin and blade) selected according to their economic importance

as given by: (a) their size relative to the whole carcass; (b) their loss in value once bruised; and (c) the frequency with which they suffer bruising in practice. A bruise was defined thus: 'A bruise will be scored if it causes trimming down to the muscle tissue (of a designated cut) of an area greater than 100mm in diameter. Given the possibility of no bruising or any combinations of four bruises (each side) there exists 16 possible combinations of scores. Each of these has a unique penalty factor which can be added for each side and multiplied by the carcass weight to give the (dollar) amount by which gross return must be adjusted to give a nett return after bruising. Producers who sell direct to an abattoir are provided with a feedback sheet which, inter alia, shows: (a) the bruise scores; (b) the price adjustment due to bruising; and (c) the nett return per body. The price adjustment (b) represents the opportunity cost of not protecting a particular animal against bruising. Furnished with this information, the producer can decide whether the cost of mitigating against bruising is worth the extra return.

CONCLUSION

The paper develops a bruise scoring and price adjustment system for cattle sold direct to an abattoir and demonstrates how this system would work in practice. A technical knowledge of bruising, together with economic principles and computer technology are combined to produce an applied system which will enhance efficiency through recognition of market realities.

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AN APPROACH TO THE STANDARDIZATION OF CONNECTIVE TISSUE CONTENT IN COMMINUTED MEAT PRODUCTS IN BULGARIA

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Currently, a new opinion is taking form that the connective tissue which is an integral part of both lean meat and adipose tissue may have an important function in the diet of human beings. Some nutrition experts and consumer groups, however, think that the connective tissue content of meat products should not exceed some limits. In this country, a formal decision was taken to introduce such limits in the current food regulations. This report describes our approach to the development and standardization of the connective tissue content limits for the comminuted meat products. Connective tissue is defined for this purpose as eight times the hydroxyprolin content.

As a first step, it was decided that our efforts should be directed towards determination of the upper limits for the collagen content in the principal groups of meat products. The approved values based on the analysis of a large number of samples of products (which formulas include collagen-rich raw materials) are as follows: (as a percentage of total protein) less than 13 % for shelf-stable and semi-stable, raw-dried and cooked and dried meat products; less than 16 % for the perishable cooked sausages,

and less than 22 % for only few types of low-value, perishable sausages.

A specific feature of the Bulgarian meat industry is the requirement that all manufacturing plants perform cutting and sorting of meat in the same way as well as they are expected to follow common formulas of the individual types of meat products. For that reason, the second step of the standardization procedure was aimed at getting the best estimate of the collagen content in meats of the typical manufacturing grades. The required data was collected by chemical analysis and the corresponding average values are as follows: (as a percentage of total protein) lean pork - 4,5 %; semi-lean pork - 12 %; fatty pork - 25 %; lard - 35 %; all-sort beef - 11 %; beef trimmings - 18 %; all-sort veal - 15 %, etc. After that, the upper limits for the connective tissue content in the individual meat product types were calculated on the basis of analytical data and product formula.

At the third step, which is still underway, the calculated values for the individual types of products are to be checked as compared to the corresponding values obtained by chemical analyses. In this report we present the data on the group of shelf-stable, raw-dried salami. In general, the calculated limits agree well with the values obtained in the laboratory. Final approval of these group limits is due soon. Further work is underway to set and approve limits for the remaining types of comminuted meat products.

9:6

MANUFACTURE OF COARSE-GROUND DRIED MEAT PRODUCTS OF A PROGRAMMED COMPOSITION

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Experiments were made, under industrial conditions, to manufacture a coarse-ground dried smoked-and-cooked sausage, cervelat. In experimental samples, the initial raw materials were pre-simulated using a computer programme, and control samples were manufactured in accordance with the standard technology.

In experimental samples, raw materials were pre-ground in a 30-32 mm plate grinder, homogenized individually in an express analysis apparatus and, after the estimation of correction ingredients, were allowed to stand at a temperature of -8°C + -10°C for 8-12 hours in order to get firmer.

Upon the mechanical treatment, the correction raw materials were added, and also curing materials and spices, estimated according to a formula in compliance with the size of the respective cutter. Filling, cooking and drying took place in accordance with the standard technology of manufacturing dried smoked and cooked sausages.

ments.

Upon the comparative analysis, significant differences were found between experimental samples and controls for $P > 0,001$ with respect to the characteristics of fat content in dry substance.

In conclusion, it could be stated that, upon the manufacture of coarse-ground dried meat products, it is possible to use pre-blending of initial raw materials without any adverse effects on product structure. This can be attained by grinding the meat using a plate with 30-32 mm openings, blending and allowing to stand in a cooler to get firmer. Finished products have standard chemical characteristics and are of a stable quality.

Experi

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ON SELECTION OF THE OPTIMUM REGIEME FOR
CANNED MEATS PASTEURIZATION

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characteristics change is found and a new
stepwise regime for pasteurization is sub-
stantiated; the latter allows to manufac-
ture products of high quality and stable
during storage.

Currently various regimes for canned meats
heating are used in the world for pasteuriz-
ed canned products manufacturing. Each of
them has disadvantages. That is why develop-
ment of the optimum regime for canned meats
pasteurization is an actual problem.
At pasteurization regime selection two tasks
are raised: inhibition of viable microflora
being able to cause microbiological deterio-
ration of canned products during storage,
and manufacturing of high quality products.
It is known that as higher the temperature
and longer the heating process than the
guarantee of microbiological deterioration
absence is greater. At the same time quali-
tative parameters of a product significant-
ly diminish in these condition, firstly,
juiciness, tenderness, consistency; besides
separation of liquid phase increases.
In this connection it is necessary to select
a such regime for pasteurization that will
allow to eliminate the abovementioned dis-
advantages.

While studying physico-chemical, structure-
mechanical, biophysical, biochemical, micro-
biological, hystological and organoleptical
qualitative characteristics of beef pas-
teurized canned products dynamics of these

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SYSTEMIC ANALYSIS AND OPTIMIZATION OF TECH-
NOLOGICAL SYSTEMS OF MEAT PROCESSING

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elements of the biological value of compo-
nents. At all the levels a system of the cri-
terial estimates of the efficiency and qua-
lity of meat processing and a system of re-
strictions based upon the normatives and
standards regulating products manufacture
were developed. As an economic criterium
the maximum profit is suggested, as an for-
mulation-assortment criterium - the minimum
deflection from the pre-set assortment and
recipe in their absolute, relative and squ-
are expression. As restrictions, limits
for the raw materials, product assortment
and formulations are used. At the second le-
vel of optimization supplementary criteria
are added which express the minimum devia-
tion from the pre-set chemical composition
of products and restrictions relative to the
chemical composition. At the third level
the criteria of the maximum biological value
and the minimum deviation from the pre-set
amino acid composition are introduced.

The basic probabilistic criterium of the
efficiency of animal materials processing
starting from the biological value of the
initial raw materials and the finished pro-
duct is the entropy difference of meat
products qualitative characteristics prior
to and after processing. If the uncertainty
of the quality state of the finished product
is higher as compared to that of initial ma-
terials, the production process is unable,
therefore, to respond to the disturbances
of the environmental parametres from the
viewpoint of stabilizing the quality of com-
bination meat products.

The indices of quality and biological value
are controlled through the structural optimi-
zation of the assortment of the manufactu-
red products and of the formulations by re-
placing component with the same initial
products or their equivalents but having
different qualitative and biological charac-
teristics. Structure stabilization of a tech-
nological system of meat processing can be
performed at the three levels, viz., at the
level of formulation components of combina-
tion meat products, at the level of the che-
mical composition of the components of the
initial raw materials, at the level of the

The suggested system of an optimum meat pro-
cessing plant includes a personal computer
which allows to select - on a dialogue basis
as related to the production situation - an
optimization criterium and to calculate opti-
mum recipes of meat products with account
for any given restriction on assortment and
raw materials.