COMPLEX EVALUATION OF THE QUALITY OF CATTLE AND PIGS

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SUMMARY

The paper reviews a new approach to the evaluation of cattle and pigs, coming for processing, developed on the basis of established relationships between carcasses and meat and such factors as sex, age, orientation of productivity.
The approach provides for operational objective evaluation of raw materials by means of a complex criterion on the basis of folding of unit indices.

Introduction

The existing system of evaluation and classification of cattle and pigs is essentially based on descriptive characteristics, not stimulating production of high-quality meat products.

The problem of quality improvement of meat products can be achieved only under the condition of objective evaluation of slaughter animals coming for processing.

This research was aimed at the development of complex index, allowing to use instead of a lot of numerical characteristics a certain number, determining the quality of beef and pig carcasses and meat.

Materials and Methods

The objects of investigations were youngesters of the cattle and pigs of different sex and age, raised under the conditions of specialized husbandries, as well as the sides, obtained after slaughter. The control processings of the cattle were carried out on separate groups of the animals: bulls, heifers, steers at the age of 12, 18, 24 and 36 months and pigs on groups: barrows, gilts and boars at the age of 6 to 9 months.

When forming the experimental groups the orientation of productivity of amimals was also taken into account: meat, combined and dairy for the cattle and lard, meat and universal - for pigs.

To determine the quality characteristics of the carcasses and degree of their full meatness, the carcasses were deboned, and their morphological composition was studied: content of muscular, fatty and bony tissue. The protein content, protein quality index (oxyproline/tryptophane), water-holding capacity were determined to describe the quality of meat and its nutritional and technological properties.

The data obtained were subjected to mathematical treatment, the relationships were established, and a complex quality index was calculated. In selection of a range of indices, being included in the complex criterion, we were guided by the following requirements:
- original information on raw materials quality must be maximum reliable (the technique of indices measurment has been worked through and creates no problems);
- a set of unit indices must describe as large number of raw materials properties, as possible;
- unit indices must be interrelated between each other to a less possible extent.

A complex evaluation of carcasses quality was carried out on the basis of multiplicative model, having the form:

$$d = \sqrt[h]{d_1 \times d_2 \times d_3 \times \ldots d_n}$$

where d - complex index of quality;
$d_1, d_2, d_3 \ldots d_n$-corresponding values of unit quality indices in the scale of desirability.

The complex criterion of quality is a dimensionless value, determining the quality level of uniform produce and can be used as a criterion for differentiated carcasses grading.

Unit indices, determining the quantitative and qualitative characteristics of raw materials properties were used for building the complex criterion.

The scale of normalization of unit quality indices was build with the help of functions of Harrington. The idea of transformation of natural values of unit quality indices into dimensionless scale of desirability or preference, lying in yhe interval from 0 to 1 is in the basis of these functions.

To evaluate the influence of the factors (sex, age, orientation of productivity) on carcasses quality (mass of carcass, yield of fat, flesh and muscle proportion and meat), content of protein, protein quality index (PQI), water-holding capacity, the following criteria were used:

F - criterion of Fisher

A table value F at_$\alpha = 0.05$ for determination of the influence of orientation of productivity for the cattle is 3.8 and for pigs - 3.5; for determination of the influence of cattle age - 2.6 and of pigs - 3.0.

t - criterion of Student

A table value t at_$\alpha = 0.05$ for determination of the influence of sex of the animals is 2.2 both for the cattle and for pigs.

Results and Discussion

The results of the investigations suggest that the index of carcass mass is a highly reliable quality criterion of the cattle youngesters. The carcass mass of the heifers of meat orientation of productivity is by 7 kg greater than of the heifers of combined orientation of productivity and by 15 kg greater than of the heifers of dairy breeds. A much greater difference in carcass mass dependent on productivity was observed in the case of bulls - 19 and 24 kg, respectively ($F = 7.78$). It was also found that there is a direct relation between the value of mass of the carcass and age of animals. A general feature for the youngesters of different sex is an increase in the carcass mass with the growth and development of the animal. Thus, the carcass mass of bulls at 24 months is by 56 kg greater, and at 36 months by 104 kg greater, as compared to animals at 1 year ($F = 72.255$). A similar pattern is observed in the case of heifers and steers.

A yield of the flesh production and a proportion of muscle and fat tissue therein is an important index in carcass evaluation both for processing and for retail sale.

The yield of flesh portion in beef breed is significantly greater than that in the dairy and combined breeds of the cattle at the same age. There is a direct relation between meat content in the carcass and the age of the animals: the older the animal, the higher is the content of meat and there are less bones. Simultaneously as the age increases, so does the yield of the fat, which is particularly characteristic of the heifers and ateers. The difference between steers and heifers, as far as this index is concerned, is not significant. The youngesters of the beef breed contain significantly less fat, compared to the carcass of the combined and dairy orientation of productivity ($F = 3.66$; 12.427; 12.367). The data obtained indicate sufficiently close relationship of the studied indices with age, sex and orientation of productivity of the animals.

Investigations of physico-chemical and technological properties of meat with regard to the studied factors suggest that the orientation of productivity has an essential influence on protein content in meat. The heifers of meaty type had by 0.42% greater protein content in muscular tissue, as compared to the dairy cattle ($F = 3.844$), and in the case of steers this difference is 0.58% ($F = 2.614$), and in bulls - 0.40% ($F = 5.816$). Age has certain influence on protein quality index (PQI). The content of oxyproline decreases with age, and PQI accordingly increases. F-criterion for heifers is 3.5, for bulls - 8.3 and for steers - 41.05, which evidences about a significant influence of animals age on protein quality. Sex of animals has a significant influence on meat water-holding capacity (WHC). Thus, WHC of bulls meat is 75.42% which is by 12.12% higher, than in the case of heifers and by 10.02% higher, than for steers.

The orientation of productivity has an effect on WHC as well. Thus, WHC of muscular tissue of youngesters of meat type is by 2.96% higher, than that of the animals of combined type.

Based on mathematical treatment a set of indices was selected which characterize the quality of carcasses and meat of the cattle youngesters to a maximum extent: carcass mass, yield of meat flesh, yield of fat, content of protein in muscular tissue, PQI and WHC.

Similar investigations were carried out on slaughter pigs. It was found that the orientation of productivity has an essential influence on mass of the carcass. Thus, the barrows of lard orientation of productivity on average had a mass of the carcass by 1.4 kg greater, than that of the universal orientation, and by 3.6 kg greater than the barrows of the meat orientation ($F = 3.91$). As for the boars, the difference in this index is 1.2 kg and 2.6 kg, respectively ($F = 3.61$); for gilts - 1.8 kg and 1.8 kg ($F = 3.62$).

The age of slaughter animals has a very important influence on carcass mass value of barrows ($F = 63.78$), boars ($F = 112.69$) and gilts ($F = 114.68$). The barrows of 6 months age on average had a carcass mass

by 18.5 kg less, than that of the barrows of 9 months age; for the boars this difference is 17.8 kg; for gilts - 18.6 kg.

A great influence of orientation of productivity of muscular tissue yield was found. On average, the content of muscular tissue in barrows of meat orientation of productivity was by 9.3% higher, than that of the lard barrows and by 4.0%, than that of the barrows of universal type (F = 69.30). For boars this difference is respectively 10.6% and 5.2% (F = 65.83), for gilts 9.8 and 4.1% (F = 49.51). The differences in the content of muscular tissue in carcasses of the animal at the age of 6 and 9 months are as follows: for barrows 5.1% (F = 12.18), boars - 5.2% (F = 9.72), gilts - 4.6% (F = 6.18). Orientation of productivity and age had a great influence on carcass fat content: the fat yield of 6-months age barrows is 3.8 lower than that of 8-months age ones (F = 10.37); for boars this figure is 5.5% (F = 19.57) and for gilts - 4.3% (F = 15.96). A great influence of the orientation of productivity on protein content in meat was established. The meat of the barrows of lard type had protein content by 3.0% higher than that of the barrows of the meat type (F = 94.52); for boars this difference was respectively 3.8% (F = 24.06), for gilts - 3.4% (F = 248.07).
The influence of pigs age on protein content in pork was not established.

The water-holding capacity of pork is more affected by the orientation of productivity, than by the age of the animals. Thus, WHC of muscular tissue of barrows of lard type is by 4.0% higher, than for boars of meat type (F = 23.42); for boars meat this difference is 5.0% (F = 25.34), for gilts - 3.8% (F = 15.408). WHC of meat of 6-months age barrows is by 2.3% lower as compared to WHC of meat of 9-months barrows (F = 4.47); for boars this difference is 2.3% (F = 3.00), for gilts - 2.6% (F = 4.578).

A great influence of animals sex on the studied indices was revealed:
- a carcass mass of boars is by 3.0% less than that of barrows (t = 12.938) and of gilts (t = 8.772);
- maximum content of muscular tissue of boars carcasses was 57.47%, which is by 1.6% lower, than in the barrows carcasses (t = 6.630), and by 1.3% lower, than in gilts carcasses (t = 6.283);
- difference in fatty tissue content of boars and gilts carcasses is 1.4% (t = 3.599). Boars carcasses contain much less fatty tissue;
- boars meat contains on average by 0.2% more protein, as compared to meat of barrows (t = 2.234) and by 0.1%, as compared to meat of gilts (t = 2.451);
- the water-holding capacity of gilts meat is by 0.6% higher than that of boars (t = 1.757), and by 0.3% higher, than that of barrows (t = 3.563).

Based on mathematical treatment of indices, characterizing the quality of carcasses and meat to maximum extent, the scales of desirability were built and a complex index of quality for the cattle and pigs (Tables 1, 2) was calculated.

Conclusion

A complex criterion of quality as built on the basis of indices covering most fully the information about quality of raw materials and taking into account all the range of requirements imposed can be used for differentiated system of grading of the cattle and pigs.

Table 1. Complex index of quality evalution of cattle.
Table 2. Complex index of quality evalution of pig carcasses.