MECHANICAL CHARACTERISTICS OF ANIMAL BIOMATERIALS IN THE QUALITY PARAMETER SYSTEM FOR MEAT RAW MATERIALS AND MEAT PRODUCTS

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Theoretical and experimental studies on the mechanical characteristics of biomaterials of animal origin are a vital problem for meat science and technology. Products to be manufactured as a result of live-stock slaughtering and processing represent multi-component biosystems of a complex structure, their characteristics being changed during commercial processing of raw materials, what has a decisive influence on the quality of products manufactured. In this connection, mechanical characteristics of meat raw materials are of a high importance for solving specific engineering and designing as well as technological problems in the meat industry /1/.
On the one hand, mechanical processes are accompanied by force actions on raw materials from the part of working elements of machines what influences the performance of a processing equipment.
On the other hand, a quality assessment of biological systems by the method of mathematic modelling mechanical characteristics of raw materials and products allows to develop instrumental methods for tenderness and consistency evaluation of meat products.
In the present work a classification of mechanical characteristics of animal bio-tissues for experimental researching and mathematical modelling of these characteristics is proposed.
In polymer mechanics the following classification of animal biological raw materials (meat) as objects for experimental and theoretical studies on their mechanical characteristics is accepted: compact bone tissue, muscular tissue and soft collagen-containing materials. This classification completely corresponds with that one to be accepted in the industry and trade which is based on the food value and technological use of meat tissues.
From point of view of polymer mechanics meat tissues show mechanical properties of both rigid and soft biomaterials, these properties being largely temperature factor-dependent. According to a temperature meat tissues can show properties of either one or another class of biopolymers: e. g. at room temperature a meat tissue shows properties of soft biomaterials, at subcryogenic temperatures those of rigid biomaterials.
In this connection, it is suggested to use a whole range of parameters which could in full measure characterize a mechanical behaviour of animal biomaterials. Mechanical characteristics of biomaterials of animal origin are divided into three groups (see Fig. 1): 1 - elastic and deformative ones are determined by constructing deformation diagrams for samples of a biomaterial under study, these diagrams being constructed in a static or a dynamic mode according to testing objectives. The different schemes of testing are used - compression, stretching, bending, etc. /2/; 11 - strength characteristics; for their determination the rate of a sample deformation is of great importance. Thus, while constructing diagrams in the dynamic mode a strength limit of a biomaterial under study can be obtained. These characteristics are required for designing an equipment with high-speed cutting devices; 111 - viscoelastic characteristics; for their studying a creep test and a stress relaxation test are carried out. On their results physical laws are formulated which connect the stress "σ", the deformation "ε" and the time "t". These laws are represented as mathematical models of the mechanical behaviour of a biomaterial under load /3/.
For certification of elastic, deformative, strength and viscoelastic properties of biomaterials of animal origin the following main mechanical characteristics were chosen by us which are tabulated below:
Tab. 1: The main mechanical characteristics

The main mechanical parameters of biomaterials	Units of measurement /Coordinates/	Mechanical properties of biomaterials
Static strength limit, σ_{sb}	Pa	Strength
Static elasticity modulus, Es	Pa	Elastic, deformative
Dynamic strength limit, σ_{db}	Pa	Strength
Dynamic elasticity modulus, Ed	Pa	Elastic, deformative
Poisson´s ratio, μ	unitless	Elastic, deformative
Modulus of shearing, G	Pa	Elastic, deformative
Bulk elasticity modulus, K	Pa	Elastic, deformative
Dynamic σ-ε diagram	Pa-%	Elastic, deformative
Static σ-ε diagram	Pa-%	Elastic, deformative
Creep curves ε-t σ=const	%-s	Viscoelastic
Stress relaxation curves σ-t ε=const	Pa-s	Viscoelastic

By certification data we mean the whole complex of parameters and/or functions pre-definition of which results in calculating mechanical characteristics at any predetermined instant of time under predetermined external influences.
Certification data of mechanical properties of biotissues were developed, as applied to specific problems concerned with creating a database of mechanical properties of biomaterials. These data include tabulated functions of viscoelasticity, dynamic and static properties to be measured by experiments. For determination of functions a standard system for biomaterial testing was developed /4/.
Results of the present work were used in studies on creating a database of properties of animal biomaterials which are carried out in All-Russian Research Institute of Meat Industry since 1991.

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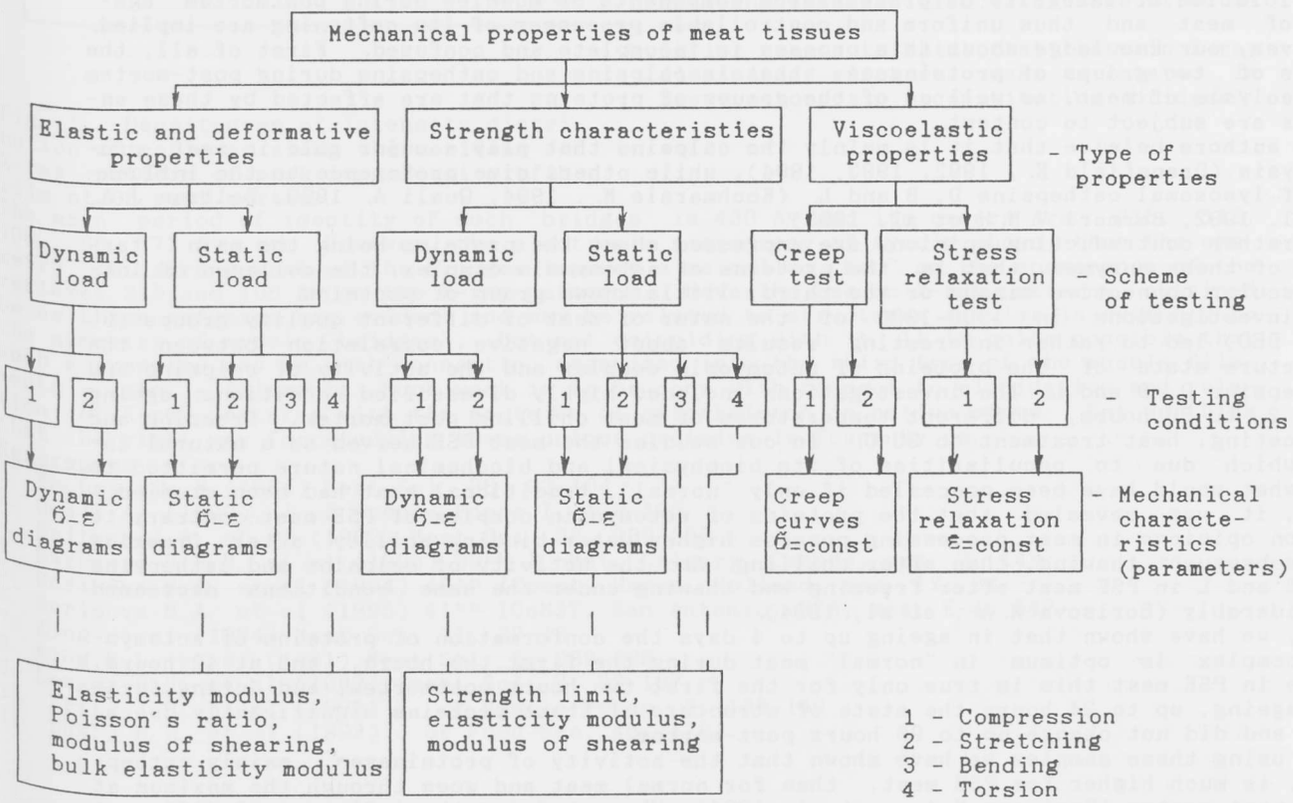

Fig. 1: Structure of mechanical properties of meat tissues