THE EFFECT OF GLYCOLYSIS ON THE BIOLOGICAL VALUE OF DUCK MEAT

V.P.Panov

Voronezh Technological Institute, Voronezh, USSR.

SUMMARY

It has been found that there is a positive correlation between the protein attacking by digestive tract enzymes in vitro and the biological value by 120 h glycolysis of duck meat (grade I and II). The rate and the degree of protein digestibility depends on the stage of meat ageing.

Autolytic processes taking place in poultry meat after slaughtering influence the meat quality and in many cases predetermine its food and biological value. It has been found that the highest protein hydrolysis degree resulting from the action of digestive enzymes is reached by the end of 120 h glycolysis in the first-grade duck meat was well as in the second-grade one. The relatively slow digestion of the second-grade duck meat is very likely due to the large proportion of connective tissues and to the structural difficulties of the interaction between enzymes and proteins. The integral score value for duck meat of the first and second grades has been shown to be 8.99 and 9.04% of answering the balanced nutrition formula, respectively. According to the present-day biochemical concepts (Solovjev 1966, Chemikoiv 1975, Pokrovsky 1975, Dujic 1978, Ugolev 1986) it is quite obvious that the proteolysis during meat glycolysis occurs as an "explosive" breakdown of protein molecules with the immediate formation of the final reaction products. Thus it may be assumed that the biological value index of duck meat changes during glycolysis as a result of structural changes in protein molecules themselves and their interaction with other components, the protein digestion rate and degree being dependent on the stage of meat maturing.

The present-day concepts of biological and nutritive value of foods are based on the principles of balanced and adequate nutrition theories (Prokrovsky and Ertanov 1965, Pokrovsky 1975), Chemikov 1975, Ugolev 1986, Rogov et al 1987). Autolytic processes taking place in chilled poultry meat during storage predetermine its biological value.

In this connection it should be noted that the biological value reflects the quality of the product's protein components connected both with the protein digestion and with the balancing degree of its amino acids composition (Ugolev 1986).

Despite the increasing interest in the poultry meat processing there is limited information on the changes in protein biological value during glycolysis and digestion.

The objective of this paper is to study the food and biological values of duck meat during maturing, the rate and the degree of its digestibility in vitro.

The carcasses of the first and second-grade ducks obtained after commercial slaughtering and initial treatment were investigated. The carcasses packed under vacuum in Saran film (Povidan) were stored for 5 days at 275-277K in the cold store. The total content of moisture, protein, fat ash and pH were determined by the conventional techniques (Zhuravskaya et al. 1985). The amino acid composition of the samples was studied in a model AM-881 automatic amino acid analyser (Chech.). To obtain the full characteristics of the biological value of duck meat protein digestibility has been determined by the technique using proteolytic enzymes of the digestive tract (Pokrovsky and Ertanov 1965). The protein digestibility degree was estimated by the tryosine amount stored during hydrolysis by measuring the optical density of the dialysate at 280 nM in a CF-16A spectrophotometer. The obtained data were subjected to the mathematical statistics.

The experimental data show that the chemical composition and nutritive value of duck meat differ in the content of protein, fat and moisture depending upon the poultry grade (Table 1).

Chemical Composition of duck meat (% per 100 g produot)

indexes	carcasses of ducks	
	grade I	grade II
total moisture	45,6±0,5	56,5±0,4
total protein	15,8±0,9	17,3±0,5
fat content	38,0±0,45	24,2±0,5
ash	0,6±0,15	0,9±0,1
protein/fat ratio	0,42±0,03	0,71±0,04
caloricity, Kj	1695±16	1201±20

In order to obtain fuller characteristics of the biological value of duck meat proteins amino acid scores were estimated (Table 2) by the method suggested by the international organisation FAO/WHO (Pokrovsky 1975).

Integral score method gives the possibility to reveal all advantages and disadvantages of food products (Pokrovsky 1975). The estimations have shown that the integral score value for duck meat of the first and second grades are 8.99 and 9.0% of answering the balanced nutrition formula, respectively.

Amino acid score of duck meat (% per 100 g product)

Amino acids	duck meat	
	grade I	grade II
isoleucine	I,05	I,15
leucine	I,14	I,18
lysine	I,50	I,29
methionine + cystine	0,88	0,91
phenylalanine + tyrosine	I,16	I,20
threonine	I,12	I,09
tryptophane	I,16	I,21
valine	0.98	I.0I

The results of the investigations on the rate and the degree of the duck meat (of both grades) protein digestibility in vitro during maturing show that the amount of hydrolysis products depends on the glycolysis rate and nature in muscular tissue (Fig. 1, 2). The first-grade duck meat showed the highest hydrolysis degree of proteins under the influence of digestive enzymes by the end of 120 h glycolysis (Fig.1, curve 1-5). The relatively slow digestion of the second-grade duck meat is probably associated with a great deal of connective tissue and with the structural difficulties of contacting between enzyme and proteins owing to the shift of the meat pH to the isoelectric point of muscular proteins. It is also associated with the change of their ionisation degree and with the increase of the interaction between molecules.

One may assume that the conformation changes in raw materials influence the character of meat protein changes during ageing. The results in the formation of complexes which are more stable to the action of digestive enzymes. The duck meat proteins have different stability degrees to the action of proteinases depending upon the poultry grade. Different stability degrees are also due to hydration levels of muscular proteins (Solovjev 1966, Dujic 1978).

The increase of protein stability to the action of digestive enzymes during rigor mortis may be caused by the formation of specific links which are not destroyed by these enzymes and by the decrease of the peptide bonds accessibility due to the aggregating protein molecules (Solovjev 1966). The increase of protein attacking bez enzymes during meat ageing may be explained by their change resulting from the pH increase and the weakening of actin-myosin link. Apparently the proteolysis during meat maturing occurs as an "explosive" protein molecule breakdown with the immediate formation of the reaction final products according to the modern biochemical concepts (Solovjev 1966, Pokrovsky 1975, Chernikov 1975, Dujic 1978, Ugolev 1986).

Thus, it may be assumed that the duck meat biological value index changes during ageing as a result of the protein molecule structure changes and their interaction with other components.

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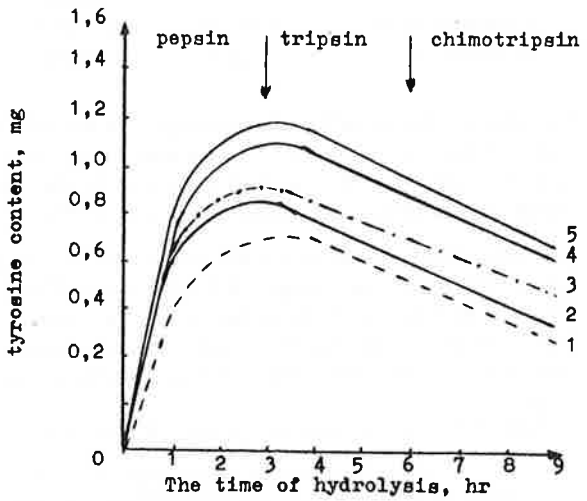

Fig.1. Attacking rate of the first-grade duck meat proteins during maturing
1 - 24hr; 2 - 48hr; 3 - 72hr; 4 - 96hr; 5 - 120hr.

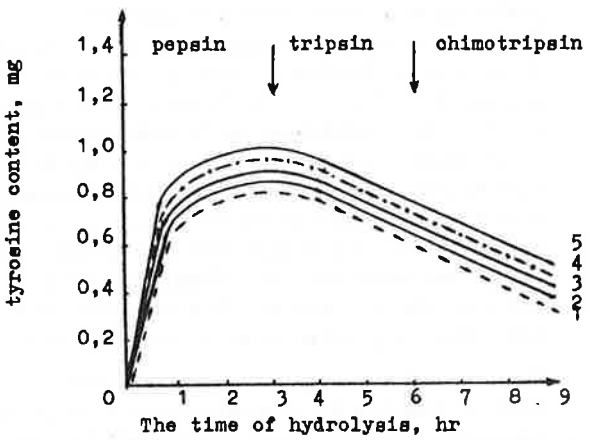

Fig.2. Attacking rate of the second-grade duck meat proteins during maturing
1 - 24hr; 2 - 48hr; 3 - 72hr; 4 - 96hr; 5 - 120 hr.