

DOI: 10.5281/zenodo.4288320
CZU 637.514.9:637.514.5.04/05



QUALITY PARAMETERS OF COLLAGEN CONTAINING RAW MATERIALS AND COURSES OF THEIR USE

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Received: 10. 12. 2020

Accepted: 11. 22. 2020

Abstract. Quality parameters of stuffs, namely collagen containing minced meat (CMM) and collagen containing gel (CCG), obtained by processing of hen legs are presented in this work. The effect of the said characteristics upon finished meat products is investigated, recommendations for their use in technology of meat products are given. To achieve this goal, hen legs were processed according to a scheme providing for their two-stage processing by cooking in water at a temperature of (95 ± 5) °C for 60 min, separation of the broth and subsequent mechanical separation of bones from the cooked legs on a press. CMM is the raw material crushed after separation and CCG is obtained by mixing CMM with broth in a ratio of 1: 1. An evaluation of the quality parameters of CMM and CCG let it conclude that they are a promising raw materials for the meat industry, containing a significant amount of total protein, collagen and possessing good sensorial characteristics. It was defined that the addition of 20% CMM or 20% CCG to minced meat influences the rheological parameters of the finished products: the final shear stress and elasticity in the samples with CMM show higher values than in the control; in the samples with GCC there was an increase in the elasticity index. It is concluded that it is important to establish a differential approach to the use of collagen-like raw materials in the composition of minced meat, which takes into account the peculiarities of the characteristics of CMM and CCG. The results obtained helped in developing recommendations upon the areas of CMM and CCG use in the technology of meat products.

Keywords: *collagen containing raw materials, collagen mince, collagen gel, hen legs, sensorial parameters, rheological parameters, chemical parameters, recommendations.*

Introduction

The most important components of successful business of poultry farmers and poultry processing companies include deep processing of poultry meat, that is, setting up the production of such an assortment of poultry meat products, which allows rational use of

available raw materials and gives additional profits [1 - 4]. Animal processing waste is a valuable source of protein, used, in particular, for food purposes [5, 6], for the production of feed for farm animals and pets [7], etc.

In particular, specialists of the meat processing industry pay great attention to finding new methods of processing secondary raw materials for their more efficient use in the production of high-quality meat products.

Rational use of connective tissue proteins obtained from raw meat makes it possible to solve many issues of meat production: to compensate for the deficit of muscle protein resources, to reduce the cost of finished products (without reducing nutritional value) and to stabilize its quality while reducing the costs of beef, pork, lamb, etc. [8].

Collagen containing raw materials now account for up to three quarters of the available raw materials of meat processing enterprises in Ukraine. It is advisable to properly take advantage of the benefits of using these raw materials for food purposes, as evidenced by numerous sources. In particular, these questions are raised by scientists and specialists of scientifically developed, but densely populated countries, are constantly suffering from food shortages [9].

These scientists and specialists prove the advantage of using the above-mentioned materials of industrial poultry processing for food production, instead of resource-intensive and problematic, in an ecological sense, disposal of these materials. This opinion is also confirmed in [10, 11].

Connective tissue components enrich foods with fibers, improve the functioning of the human digestive system, and can also absorb unwanted substances, therefore, biotechnological methods of complex processing of collagen raw materials are intensively developed to obtain environmentally friendly targeted products with specified quality parameters [12, 13].

Collagen is the most important scaffold protein in living organisms of animal, plant, microbial and marine origin. The used animal raw materials, depending on the source of production, are characterized by different collagen content [13, 14].

Collagens are homo- and heterotrimeric molecules composed of three polypeptide chains. The general term "collagen" encompasses a large group of proteins, which in vertebrates are composed of twenty different molecules or more than thirty genetically different polypeptide chains [15 - 17].

It is known that the protein content in poultry skin is high (up to 21%), and most of this protein is collagen capable of affecting the functional properties of myofibril proteins at a high collagen concentration.

Collagen can cause a decrease in the size (shrinkage) of semi-finished meat products (especially in the case of high-temperature processing), and can also affect the binding capacity of meat pieces in the formed products [18 - 20]. Excessive collagen content in food products can significantly change flavor and aroma ranges of products, providing undesirable "hard" taste. Collagen itself is not a separate component, but a mixture of proteins with similar polypeptide chains [21].

Hen legs make up about 5% of the weight of a slaughtered bird. The gastronomic traditions of some nations tolerate their consumption after culinary preparation, although most are still discarded. Since hen legs contain a large amount of protein (mainly collagen), it is possible to turn them into valuable products, for example, gelatin or hydrolyzate, which can be used in pharmaceuticals, medicine, cosmetics or food industry [8, 10, 22].

Therefore, it is advisable to properly take advantage of the benefits of involving these raw materials in food production.

The increase in the use of collagen containing raw materials depends on its quality parameters, which can change while effected by various factors, which is confirmed by our own research [9, 23]. Unfortunately, the lack of systematized scientifically substantiated data on effective methods of processing hen legs and the functional and technological properties of the obtained collagen raw materials hinders the increase in the volume of procurement of such raw materials on an industrial scale and its rational use.

According to the research results of many authors [24 - 26], it is known that the most suitable way of processing hen legs is to cook them in water, then to separate mechanically the flesh tissue from the bones. This method is considered to be the most promising for obtaining the final product from this raw material.

So, the purpose of the work is to study the composition and properties of collagen raw materials obtained after processing of hen legs, and to determine possible directions of use of the said materials.

Materials and methods

The objects of research were collagen raw materials obtained after preliminary processing of hen legs, of two types: collagen mince or collagen gel, and meat products containing those. In general, the procedure for obtaining and processing of hen feet corresponds to that described in [17, 22, 27, 28].

To achieve this goal, the following research methods were used:

- mass fraction of protein – according to DSTU ISO 937:2005 “Meat and meat products. Determination of nitrogen content (reference method)” [29];
- mass fraction of fat – according to DSTU 8380:2015 “Meat and meat products. Method of measurement of mass fraction of fat” [30];
- mass fraction of moisture – according to DSTU ISO 1442:2005 “Meat and meat products. Method for determination of moisture content (reference method)” [31];
- mass fraction of collagen – by the method using a standard preparation of oxyproline;
- structural and mechanical indicators: ultimate shear stress, elasticity, shear stress – by the Universal Testing Machine SANS CMT 2503 (Shenzhen SANS Testing Co Ltd, China) [20,32,33];
- sensorial assessment - according to a 5-point system [34, 35].

Results and discussion

The flesh fraction of hen legs is represented by dense connective tissue.

Therefore, the prospects of this raw material in the industrial processing should be based on preliminary treatment aimed at destroying the original structure and facilitating the removal of ballast parts (bones) in order to obtain a finished product that has a sufficient technological potential.

After preliminary studies, a two-stage scheme for processing raw materials was proposed in order to obtain collagen raw materials of two types: minced meat and gel.

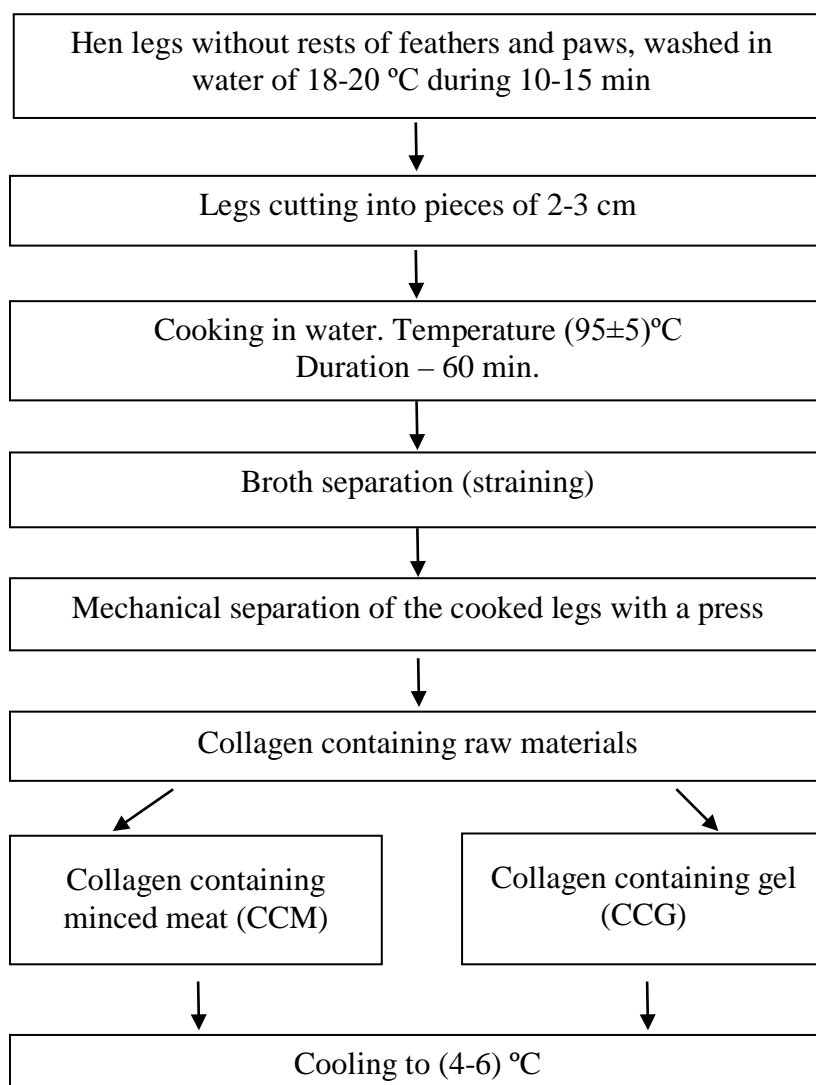


Figure 1. Methods of processing hen legs.

Collagen gel was obtained by mixing collagen mince with broth in a 1: 1 ratio.

Results of the sensorial evaluation of CMM and CCG are given in Table 1, chemical parameters – in Table 2.

Table 1

Sensorial parameters		
Parameter	Quality traits	
	CMM	CCG
Appearance	Opaque homogeneous stuff	Opaque homogeneous stuff, retaining primary shape while cooled
Consistency	Loose	Dense, elastic, does not break when pressed, easily cut, in the hot state – liquid
Aroma and flavor	Specific aroma of raw meats, neutral flavor	
Color	From creamy to light beige	

Table 2

Parameter	Chemical parameters	
	Mass fraction, %	
	CMM	CCG
Protein	20.88	10.76
Moisture	67.35	83.13
Fat	10.86	5.75
Collagen	5.24	3.84
Ratio fat:protein	1.00:1.92	1.00:1.87

The data in Table 1 and Table 2 show that CMM and CCG are promising raw materials for use in a number of products for various purposes, while it is very important to apply a differentiated approach, taking into account the special properties of CMM or CCG, namely, consistency, moisture, fat and collagen content.

The raw material obtained by two-stage processing of hen legs was evaluated from the point of view of compatibility and expediency of its use in minced meat. For this, 20% CMM or CCG was added to minced hen meat. In addition, 20% water was added to each sample. Then, the sausage casing was filled with minced meat samples and the obtained sausages were cooked in water of (95 ± 5) °C for 30 min. After cooling, the samples were evaluated for quality parameters. The evaluation results are presented in Table 3.

Table 3

Sample	Quality parameters of finished products			
	Shear force, kN/m ²	Ultimate shear stress, kN/m ²	Elasticity, kN/m ²	Sensorial value of consistency, points
Control	20.65	86.80	100.21	3.0
Experiment with CMM	21.98	101.24	185.73	5.0
Experiment with CCG	12.82	95.03	152.35	5.0

It was determined that the sample using CMM does not differ significantly from the control in terms of the shear force. At the same time, parameters of ultimate shear stress and elasticity have higher values. This means that the addition of CMM thickens the product, indicates its possible influence on the formation of one of the main consumer characteristics of sausages with a dense structure, for example, semi-smoked ones.

The sample with CCG is characterized by lower values of the shear force and ultimate shear stress than the two previous ones, but the elasticity parameter is quite high. That is, it can be expected that the addition of CCG to the minced meat composition will contribute to the formation of a more elastic structure of the product, which is important for such products as pates, sulzes and the like.

It is assumed that the addition of CMM or CCG to the minced meat improves the water-holding and fat-absorbing capacity, affects the stability of the minced meat. This assumption is confirmed by the sensorial evaluation of the consistency of the products. In

the experimental samples, it was elastic and strong. The control sample had a loose consistency, the presence of fat and broth deposits under the casing was observed.

The improvement in the consistency of the test samples in comparison with the control is due to the further disruption of bonds in the collagen molecule and an increase in the amount of gelling substances involved in the formation of a strong protein framework during heat treatment of the sausages.

In general, it can be stated that the use of hen legs for the production of meat products is possible only if they are pretreated, which provides for the separation of flesh from bones. It should be noted that the method of obtaining CMM and CCG determines the directions of their further use, namely:

- collagen containing meat mince is similar in chemical composition and structural characteristics to minced meat, therefore it is advisable to use it as a replacement for a part of raw meat in formulations of semi-smoked, cooked-smoked and cooked sausages, while its amount in smoked sausages can be from 20% to 30%, and in cooked – no more than (10-15)%. These limitations are associated with the likelihood of formation of too high density of cooked sausages, associated with the properties of collagen proteins. Collagen containing meat mince is recommended to be added at the stage of minced meat preparation for sausages along with other ingredients;

- collagen containing gel has a lower nutritional value. However, its elastic, resilient structure in the cooled state allows being recommended as an additive in products that contain a lot of moisture and require an increased amount of gelling agents. These are sulzes, brawn, liver sausages and the like. It is recommended to add collagen gel at the stage of heat treatment of meat components included in the formulation of a specific product in the amount of 10% to 15%.

Conclusion

Taking into account the properties of the structure of hen legs, the most suitable way of processing them was determined to involve two stages: boiling in water at a temperature of (95 ± 5) °C and subsequent mechanical separation of flesh from bones.

Collagen containing meat mince and collagen containing gel, which differ in chemical composition and collagen content, were obtained from the collagen containing raw materials.

The effect of CMM or CCG in the amount of 20% in the composition of minced hen meat on the quality parameters of finished products has been determined. The obtained parameters of shear force, ultimate shear stress, elasticity, consistency of products indicate a positive effect of CMM and CCG on the consistency of meat products from minced meat.

Taking into account the individual peculiarities of CMM and CCG, recommendations have been developed on the directions of their use in the technology of meat products.

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