EFFECT OF ACID HYDROLYSIS ON THE SOLUBILITY OF PROTEINS AND THE STRUCTURE OF SAUSAGES

Meelis Tikk, Kaja Põllumees, Avo Karus*, Meili Rei
Meat Institute of Estonian Agricultural University, Kreutzwaldi 58, 51014 Tartu, Estonia
* Institute of Animal Science of Estonian Agricultural University, Kreutzwaldi 1, 51014 Tartu, Estonia

Key words: connective tissue, hydrolysis, structure of sausages

Background

The consumption of meat and meat products is ~64 kg per person a year in Estonia. The percentage of sausages is relatively high. This is partially caused by their low price. The low price is achieved due to the use of meat substitutes and ingredients like soy proteins and rind emulsion. Milk proteins and starches are added on a smaller scale.

Vegetable origin proteins (like soy proteins) were used less in Estonian meat plants ten years ago. With the introduction of new technologies the use of vegetable origin proteins has progressively risen in meat products. Good functional properties and relatively low prices are the main causes for wide range usage.

According to literature, hydrolyzed vegetable protein (HVP) imparts meat-like flavor to products, and is sometimes used to enhance the flavor in cured meats and sausages. Because of the high ionic strength, buffering capacity, and pH of HVP, it will increase the water binding capacity of meat and dissociate protein-protein aggregates, thus increasing tenderness and storage stability (Taub, 1998).

Low price, nutritional value and human appropriate biochemical composition are the main reasons for a wide range use of vegetable proteins. Besides, the use of vegetable origin proteins also lowers the self-cost and so it is profitable for producers.

A drawback is that consumers cannot get full information from the package. There are no quality categories based on meat content in Estonia yet. This could obviously be changed in the nearest future.

Beside vegetable origin proteins (soy protein) meat plants are using also animal origin proteins. Estonian meat plants mostly use rind emulsion as animal origin sausage ingredient (max 5 % of raw materials). Raw material is ground to pieces in chopper, max 2…3 mm, then chopped ice and nitrit salt (2 %) are added. After 10…24 h soaking it is consumable.

Thus, an opportunity to increase the nutritional value and digestibility of sausages is to use material of vegetable origin. Another way is to investigate and evaluate animal origin materials for a better use.

Objectives

- Study the influence of rind emulsion on sausages structure;
- increase availability of proteins from connective tissue for human consumption;
- investigate the hydrolysis regime of connective tissue as a component of sausage mixture;
- characterize biochemical changes in connective tissue and in soluble fraction during hydrolysis;
- estimate vegetable protein and hydrolyzed rind emulsion influence on the stability of fat emulsion;
- organoleptic evaluation of soluble fraction of hydrolyzed rind emulsion.

Methods

Rind emulsion was the model of connective tissue. Rind emulsion samples were made in Nõo Meat Processing Plant because rind emulsion is used as sausage ingredient there.

Two different grindings were made in chopper:

- homogeneous mixture – sample I;
- up to 2…3 mm pieces – samples II and III.

Microphotos (magnification x200) were taken in the Institute of Morphology of the Faculty of Veterinary Science of Estonian Agricultural University (EAU) under supervision of professor T. Suuroja. Colouring with hematoxylin-eosin was used to photograph the microphotos.

Chemical experiments and analyses were carried out in the Laboratory of Biochemistry of the Animal Science Institute of EAU. For measuring the soluble protein concentration two different methods were used: the UV-method (UV) and the biuret reaction (B).

The soluble protein concentration of rind emulsion:water (1:9) solution was measured. One part of rind emulsion was mixed with 9 parts 1:1 HCl. 50 ml sample was taken for filtration and neutralization with 30 % NaOH every 30 minutes during 2.5 h. The protein solution was heated up to 72 °C and the concentration of soluble protein was measured.

10 % fat emulsion exfoliation speed was estimated turbidimetrically during 5 minutes on wavelength 580 nm. The results were compared with the soluble fraction of 1:9 and 1:12 soy isolate solution.

All hydrolyzed products were evaluated organoleptically.

Results and discussion

The microphoto of rind emulsion (Figure 1) shows the grinding of raw material. Collagen fibre and some other components of skin (hair follicle (h), subcutaneous adipose tissue) are confounded. On sausage microphotos it is possible to see the remains of different tissues (connective tissue, muscle fibers, adipose tissue, tendon) and cells (nerve). Figure 2 shows the structure of sausage. Fat globules (f) are emulsified with protein. Bigger particles of muscle fibre (m) and starch granule (s) can be seen.

Vegetable origin proteins have been investigated more than animal origin proteins. Vegetable proteins can be hydrolyzed in 10-20 % HCl at atmospheric or elevated pressures and then neutralized with NaOH to pH 6. After filtration and charcoal treatment, the HVP is sold as it is or spray-dried. HVP is high in sodium chloride and glutamate, and several amino acids are modified or destroyed during hydrolysis, namely, tryptophan, serine, threonine, cysteine, cystine, and methionine (Taub, 1998).

We tried to use a similar method on rind emulsion acid hydrolysis. Our results show (Figure 3) that the concentration of soluble protein of rind emulsion-water (1:9) solution was below 0.1 %. The biggest increase during hydrolysis was between 0.5 and 1.5 h. The concentration of soluble protein increased up to 20 times. Two different methods of measuring the concentration of soluble protein describe the products of hydrolysis. The biuret reaction shows the increase of peptide bounds. The UV-method shows also amino acids and shorter peptides. In particular conditions it shows a continual hydrolysis of non-soluble proteins.

Figure 4 shows the speed of fat emulsion exfoliation. The soluble fraction of soy isolate compared with the rind emulsion:water solution had relatively low stability. 2.5 h hydrolyzed rind emulsion had almost the same speed of exfoliation as soy isolate water solutions. Our results demonstrate that HVPs are successfully replaceable by animal origin hydrolyzed proteins like those from rind emulsion.

Organoleptical evaluation showed acceptability of hydrolyzed rind emulsions.

Conclusions

- Our results demonstrate that HVPs could be replaced by animal origin hydrolyzed proteins like those from rind emulsion.
- The duration of rind emulsion acid hydrolysis in the studied conditions to achieve comparable qualities with HVP will not exceed 1.5 h, which is acceptable for meat production.
- Microphotos can be helpful for investigation of sausages structure and to determine different ingredients.
- Further analyses with connective tissue are necessary for complete results.

Pertinent literature

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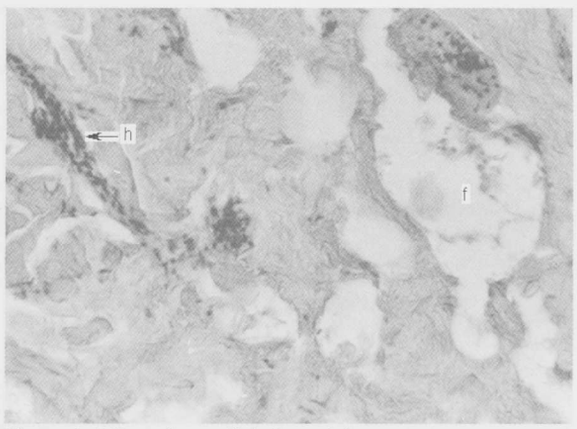

Figure 1. Microphoto of rind emulsion

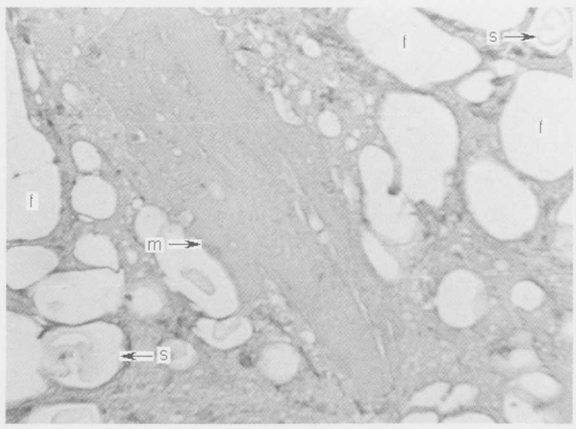

Figure 2. Microphoto of sausage

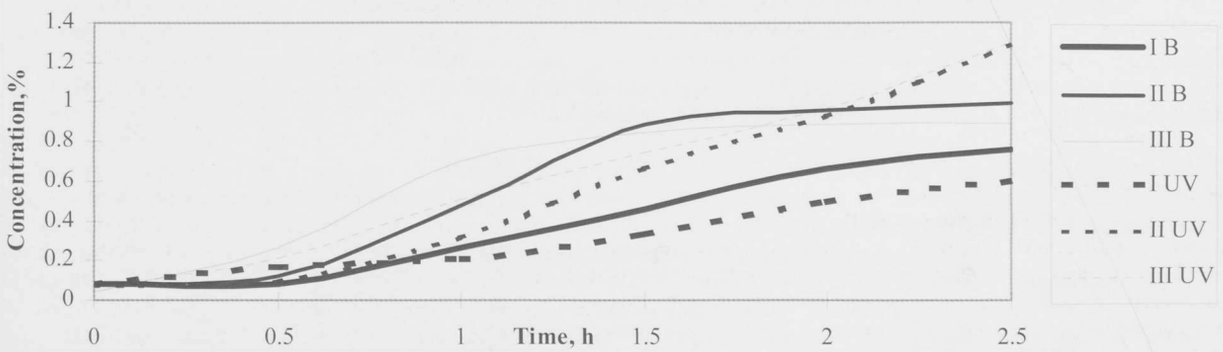

Figure 3. Increase of soluble protein concentration of rind emulsion

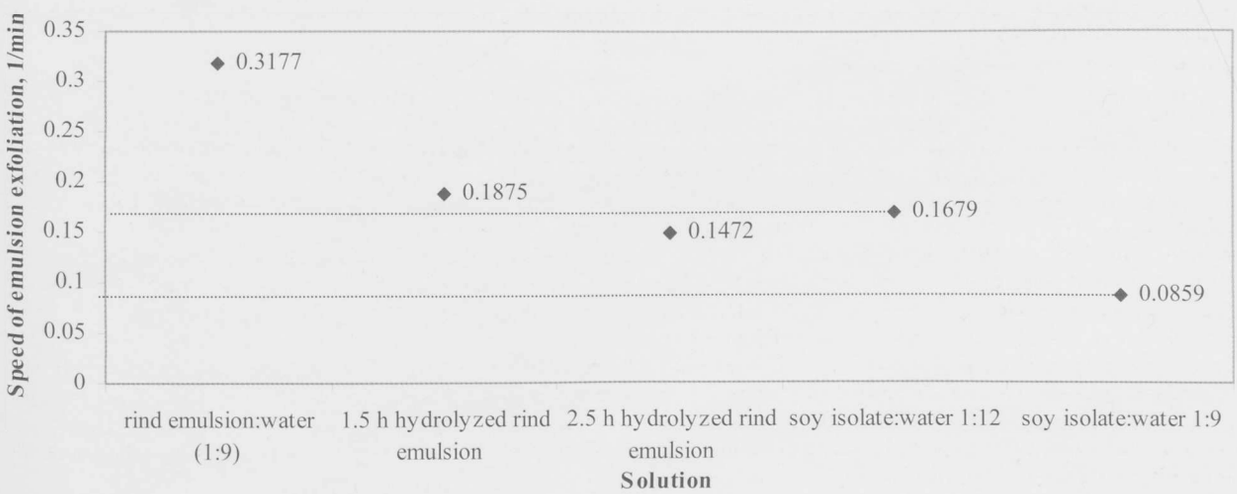

Figure 4. Emulsion exfoliation speed