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Proteases in meat processing - a preliminary study

H.-J. RAEUBER, I. KIESSLING, C. MÜLLER, A. GEISSLER
University of Technology Dresden, D-O-8027 Dresden, Germany

INTRODUCTION: It is well known that meat quality is mainly determined by its sensoric tenderness, which is caused by structural properties of muscle fibre on one hand and of connective tissue on the other hand (BAILEY, LIGHT 1989; SEUSS, HONIKEL 1989). Meat tenderi-zation for kitchen purposes by proteases is a well known approach to enhance quality. But difficulties appear in practical use mostly from the fact that proteases make more tender the muscle fibre which has been tender before treatment but connective tissue is hardly influenced. Furthermore proteases penetrate tissue very slowly, so the influenced (outer) layer is only small (RUTTLOFF 1978).
Actions of protease on comminuted meat until now have not been in the centre of interest of researchers because tenderization is not relevant in this case. Actions on comminuted process and water binding capacity of meat batter are not known (to the authors).
Aims: In the field of meat processing, esp. sausage making, it is to be investigated wether proteases
* have a real effect on collageneous particles (esp. skin)?
* influence comminution process (particle size)?
* enhance water binding capacity?
* their presence results in deviated sausage consistency?
* their activity is remaining after sausage heat treatment?
* probably resting activity in ready sausage is relevant from a nutritional and/or legal point of view?

METHODS: Investigated have been beef muscle (M. semimembranosus) from the so named "top round" and comminuted pig skin in cooked sausage and in liver sausage by sensoric, rheologic and microscopic procedures.
Enzymes applied were papain, "Thermosin" and "Thermitase".
Beef muscle was cut into pieces of 2,5 x 2 x 2 cm (appr. 10 g). The pieces after enzyme injection have been heated up to 70°C, resting in this temperature 30 min in a water bath, the untreated samples have been heated in a salt solution (stepwise 1% to 10% NaCl) bath with enzyme added. After chilling (1 hour at room temperature) measurements have been carried out.
Pig skin in meat batter was after comminuting seperately pre-treated by protease with concentrations reaching from 110 to 11 "Tyrosin units" or was comminuted together with the receipe components and enzyme solution. The batter was filled into casings and heated up to 70°C (resting 90 min), then chilled and tested.
Sensoric tests have been limited to a visual evaluation of enzyme attack to the tissue (colour deviations, destroyed structure) and haptic tests by finger tip in order to evaluate sliminess and adhesivity.
Rheological measurement was realised by a usual shear cell with constant speed, recorded the resistance force - distance - diagram. From the maximum resistance force was calculated the mean value of each experimental series.
Microscopic investigation procedure contained the following steps: cutting sample cubes, fixation in formalin solution, extraction of formalin by water, de-watering by alcohol, de-alcoholisation by xylene, imbedding in paraffine, microtom cutting, de-paraffination, staining (Goldner technique), which let appear the muscle fibre and granula in red and connective tissue in a greenish colour.
RESULTS: Beef muscle is influenced by enzyme treatment only in a thin surface layer, higher concentrations don't intensify the penetration but make the surface slimy and "mashy". Rheological measurements suffer from natural deviations in meat consistency, there was no clear result to obtain. In microscopic cuts after 90 min papain penetrated 0,4 mm, "Thermosin" and "Thermitase" penetrated 0,2 mm, see fig. 1.
Pig skin in cooked sausage: a destructive action of enzyme is clearly to be watched, see fig. 2, but sausage consistency becomes more "soft", as sensoric as rheological results prooved this. Microscopic investigations demonstrated coalescense of smaller air bubbles to bigger caveoles which likely cause the more soft consistency mentioned above.
Pig skin in liver sausage is destroyed by enzyme, the consistency becomes more creamy, fat is separated more clearly in the sausage structure.

Fig. 1: Surface layer of an enzyme attacked beef muscle piece (0,66 units of collagenase, 2% NaCl, 20 hrs. at 37°C, 30 min at 70°C)

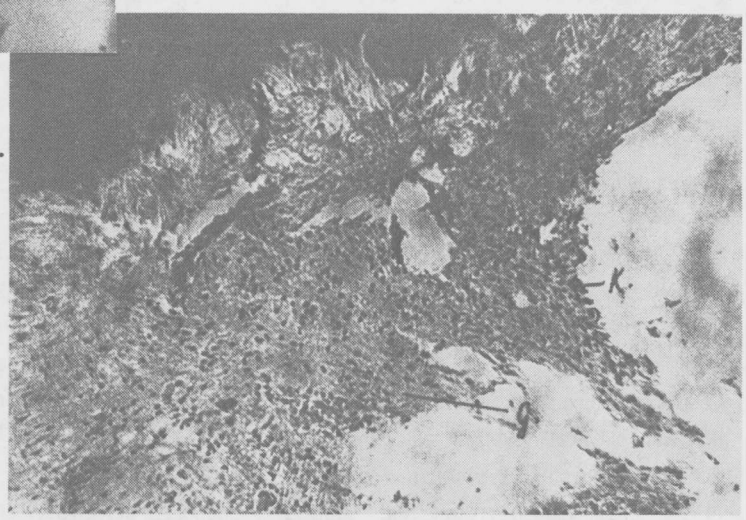

Fig. 2: Pig skin for cooked sausage, pretreated by 110 units of "Thermosin" (thermostable protease); swollen core, fringed boundary layer, gelatin (G), nuclei (K)

UNSOLVED PROBLEMS: Selective enzyme activities are not to be measured exactly, so comparisons between different enzymes are next to impossible. Resting activity of enzymes in ready products is lower than measurement sensitivity, so discussions about nutritional (health) effects are possible only of low accuracy.

CONCLUSIONS:

* Treating meat cuts by enzymes is of no technological benefit concerning tenderness and water binding capacity.
* For cooked sausage production adding enzymes in or before the comminution process does not result in decisive improvement of water binding capacity but gives possibility to produce a "spreadable" cooked sausage of new type.
* In liver sausage enzyme application frees fat from adipose tissue, so in connection with emulsifiers eventually a high quality product is to be obtained.

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