Pressure in Meat Products During Heating

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SUMMARY: There are studied changes of strength and deformational characteristics of protein, saran and reinforced viscous casings while filling them with materials with different coefficient of side pressure. Pressure and temperature influence upon casing deformation is tested at its filling with air. While heating artificial sausage casings change their structure as the result of their volume decrease. Volume deformation of protein casing depends on the value of pressure effecting a product in it and its coefficient of side pressure. Contrary to protein and saran casings the viscous one is being shrinked insignificantly. So, one of the components of pressure in sausage products at heating is the pressure stipulated by volume deformation of sausage casings.

INTRODUCTION: Break of sausage casing and canned meats sealingness means production reject. One of the reasons is pressure formation in meat products during heating that is higher than cans and casings material strength.

The problem is complicated by the fact that pressure formation is being promoted by some technological techniques aimed to the improvement of minced meat waterbinding capacity and swelling, e.g. decrease of added water amount, not meat use, increase of added salt, phosphates, milk protein (Stiebing A., 1985).

Efforts to decrease reject level due to soft heating regimes utilization increase process time.

One of this problem solution is regulation of pressure level at minced meat stuffing taking into account casing and meat properties. Modern formation systems allow to develop the given minced meat extra pressure even at meat physico-chemical properties variation.

At sausage products heating tensions form in casing that influence a product in it. The tensions dynamics and reasons are not studied.

MATERIALS AND METHODS: There are studied change of strength and deformation characteristics of such casings as protein, saran and reinforced viscous while filling them with air and various material with different coefficient of side pressure. Casing deformation is determined by the value of displaced water volume. Pressure and temperature influence on casing deformation is tested at air filling. Air utilization as a model material is explained by the fact that at casing deformation study it is necessary to exclude the effect of model material expansion. For this purpose a safety valve is mounted in an air tube to a one end of which a casing sample is being connected; the valve releases extrapressure formed due to air thermal expansion and casing thermal skrinkage. At pressure decrease below the given value air is compressed into the casing up to the desired level.

RESULTS: During protein casings heating their volume decreases that can be explained by protein structure change. It is testified by casings size change at temperature ranges characteristic for the onset of protein denaturation (Fig.1). Saran casing skrinkage reflects material state transfer to balance at temperature increase. Unlike protein and saran casing the viscous one is being skrinked insignificantly. Expansion at the very beginning is explained by moisture absorption by fibres and at further temperature increase volume decreases to the initial one. Small deviations, due to various casing diameter, are explained by the hysteresis phenomena.

At inner extra pressure of $0.1 \cdot 10^5$Pa and $0.2 \cdot 10^5$Pa tension on protein casing walls, stipulated by thermal shrinkage, prevails over tensions due to inner pressure, and as a result casing volume decreases (Fig.2). At inner pressure of $0.4 \cdot 10^5$Pa the volume does not change at the beginning, i.e. tension caused by temperature increase is being balanced by inner pressure; then at 75-80°C volume increase starts because due to casing strength decrease inner pressure is higher than tension caused by thermal skrinkage. At inner pressure of $0.3 \cdot 10^5$ Pa casing volume does not change, i.e. inner pressure tension is being balanced by the tension stipulated by casing thermal skrinkage. Consequently, casing thermal shrinkage develops pressure of $0.3 \cdot 10^5$Pa in meat products.

The same tests with cellulose casings allowed to find out the value of pressure due to casing skrinkage of $0.4 \cdot 10^5$. These casings are firmer than other tested types. At 90°C

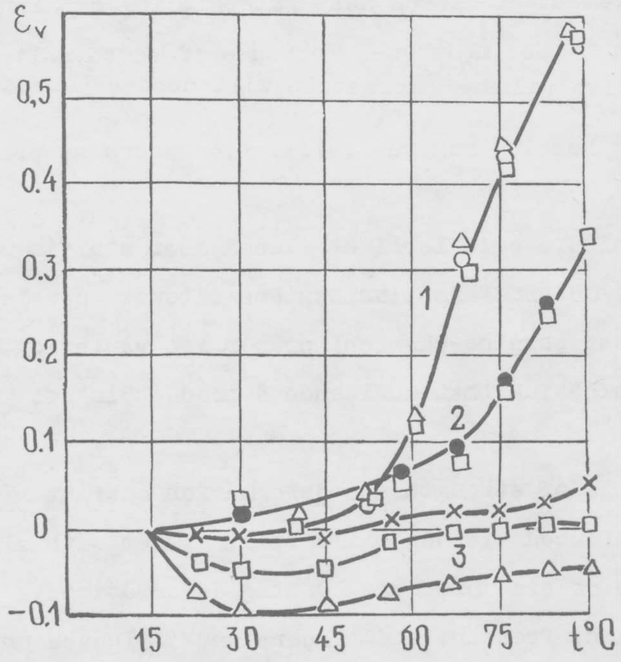

Fig.1. Relative volume deformation of various casings as related to temperature level:
1 - protein; 2 - saran; 3 - reinforced viscous; Δ - 0.045m diameter; □ - 0.055m; ○ - 0.065m; ● - 0.075m; x - 0.090m.

they resist extra pressure of $1 \cdot 10^5$Pa.

Low thermal resistance is characteristic to saran casings. The initial value of relative volume deformation does not change at heating up to 90°C at inner pressure of $0.1 \cdot 10^5$. At inner pressure increase temperature level growth causes volume rise and at $0.4 \cdot 10^5$ casing material breaks down.

Degree of longitudinal and cross extension is different for various casings. According

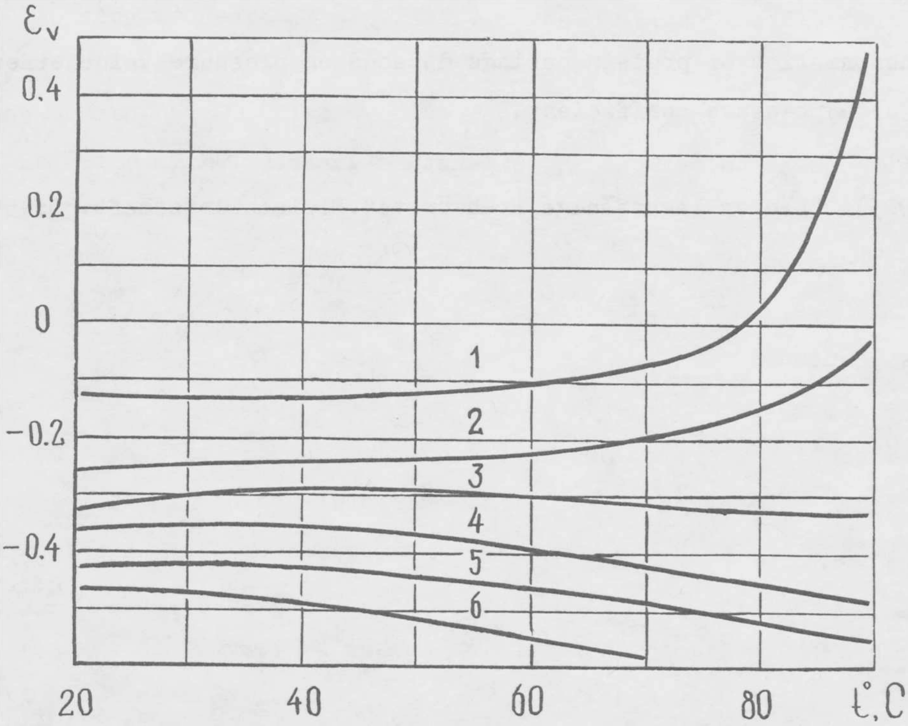

Fig.2. Relative volume deformation of protein casing (0.045m diameter) as related to temperature at various extra pressure: 1 - $0.1\cdot10^5$Pa; 2 - $0.2\cdot10^5$Pa; 3-$0.3\cdot10^5$Pa; 4-$0.4\cdot10^5$Pa; 5-$0.5\cdot10^5$Pa; 6-$0.6\cdot10^5$Pa

to data of A.S.Bolshakov for sausage casings it is 20 and 50%, correspondingly. Cosequently, at side pressure coefficient increase the relative volume deformation will decrease because longitudinal loading rises and cross loading comes down.

Treatment of test results for materials with different side pressure coefficient allowed to find out relationship between relative volume deformation and material side pressure coefficient and pressure of protein casing filling at diameter of 0.045m.

Results treatment for experiments in which protein casing (0.045m) was filled under pressure with materials of various side pressure coefficient allowed to develop the following analytical relationship:

$$\varepsilon = 1.065\,\mu^{5.3}\,(P\cdot10^{-5})^{1.95}, \qquad (1)$$

where ε - relative volume deformation of casing;

P - pressure $(0.1\div0.5)\cdot10^5$Pa;

μ - side pressure coefficient of 0.75-0.93.

<u>CONCLUSIONS</u>: 1. One of the pressure items that develops in sausage products at heating is the pressure stipulated by volume deformation of sausage casings.

2. Artificial sausage casings are being deformed at heating due to what their volume decreases.

3. Volume deformation of protein and saran casings does not depend on their diameter. Reinforced viscous casing shows insignificant increase of volume deformation at its dia-

meter rise.

4. Volume deformation of protein casings depends on pressure value effecting a product in it and its side pressure coefficient.

REFERENCES:

Stiebing A.(1985). "Länger lagerfähige Brühwürste".Fleischwirtschaft.65:450-465.