INSTRUMENTAL METHOD OF SAUSAGE MEAT AND FINISHED SAUSAGES CONSISTENCY CONTROL

T.V.KOSAYA[1], A.N.ABRAMOV[2], G.T.TUMENOVA[3], V.V.VAGIN[4]

1. The Moscow meat-packing plant, USSR
2. State Committee of the Council of Ministers for problems of Food and Purchase, USSR.
3. Scientific-Production Society "Complex", USSR
4. The All-Union Meat Research and Designing Institute, USSR

SUMMARY: In order to improve accuracy of measurement, identity of results and metrological control, investigations were fulfilled into effect of the following factors: methods of sample preparation, weight of movable part of device, penetrator type and penetration time.

INTRODUCTION: Intensification of technological processes and creation of modern on-line mechanized and automated production lines are associated with the development and application of instrumental methods for quality control of raw material and final products.

Rheological and structuro-mechanical properties refer to the group of physical attributes, showing dependence on biological and chemical composition (formulation) and inner composition (structure) of a product (A.V.Gorbatov et al., 1982).

Structuro-mechanical properties characterize behaviour of the product under conditions of stress-state and create possibilities to interrelate tension (stress), deformation and deformation rate in the process of force application.

The main structuro-mechanical properties can be graded according to the character of external forces, applied to the product and resulting deformation, into 3 groups: shift group, compression group and surface group.

Limit tension of shift, plastic and effective viscosity relate to the basic shifting parameters, determining change of products volume when it is affected by shifting tangent tensions. As compared to plastic and effective viscosity, the limit tension of shift is most sensitive to the change of technological and mechanical factors. The limit tension of shift can be determined by penetration method - by pressing into the product of foreign bodies, having different forms and dimensions. The value of limit shift tension on the linear part of "stress - deformation" curve is determined by formula of P.A.Rebinder:

$$\theta_0 = Km/h^2, \text{ Pa} \qquad (1),$$

where K - is constant of a cone, n/kg

    m - weight of penetrator, including rod and extra load, kg

    h - depth of cone immersion, m

In order to measure value of the limit shift tension, rotary viscosimeter, penetrometer and universal testing machine "Instron" were used.

For determination of limit shift tension value under industrial conditions, special device was designed and developed – penetrometer PMDP-1.

To determine adequacy of values of limit shift tension, obtained by different instruments, comparative research was done on a single sample of sausage meat.

Rotary viscosimeter RV-8 for broken structure shows significant variation of experimental data, achieving %50%. Besides, the process of obtaining rheogramms is rather long and labour-consuming. The use of this instrument in industrial conditions for fast evaluation of raw material consistency is not effective.

Universal testing machine "Instron" can relatively quickly and accurately determine value of static and dynamic limit tension of shift. This device has a range of important positive characteristics, one of them being possibility of constant evaluation of readings. High cost and necessity of qualified maintenance restrict its use in industrial conditions.

Portable device PMDP-1 (USSR Patent N 1479874, 1989) is compact, small-sized and ensures fast determination (5 sec) of ground meat limit tension of shift as well as penetration tension of finished sausage items. During the use of a knurled conic penetrometer with the angle vertex 60°, measurements are identical to the ones, received by "Instron" testing machine.

For determination of limit tension shift in industrial conditions for technological process control and assessment of final products quality, PMDP-1 device is most preferable.

In order to improve measuring accuracy, readings identity, metrological control, rheometrical investigations were conducted to reveal influence of the following factors:
- method of sample preparation;
- weight of movable part of device;
- type of penetrator;
- penetration time (5 sec, 180 sec).

Since structuro-mechanical properties of cooked sausages, containing diced fat, are less studied due to heterogeneity of dispersed composition of muscle tissue and fat, it is necessary to find way of sample preparation, that could ensure minimum error. This can allow to substitute organoleptical method of consistency evaluation by instrumental method.

MATERIALS AND METHODS: During determination of limit tension of ground meat shift in cooked smoked sausages by conic penetrometer with angle vertex 60°, measurement error was determined, reaching 10% from the mean value. To improve measuring accuracy large pieces of backfat (8 x 8 x 8 mm) were driven out of ground meat sample. As a result, standard error achieved 6-7%, which can be explained by relatively large share

of big enough pieces of muscle tissue. As ground meat for semi-smoked and cooked smoked sausages is not structurally uniform, it was ground once more, using 2 mm plate. Due to this factor the value of limit tension of shift lowered by 20% as compared to non-ground sausage meat. Variation of experimental data also changed, having reached 5%.

To determine consistency of final sausages, measurements of an intact sample were made, using 4-needle penetrometer and a cone with vertex angle 10°. In the first case variation of experimental data was 8-10%, in the second case – 5%. In order to improve accuracy of measurement and to obtain a more uniform structure (taking into account chemical composition of sausages), samples were also ground using plate with openings diameter 2 mm. Measuring error was not more than 3-4%.

Thus, judging by results of conducted research, one can reveal positive effect of samples grinding through 2 mm plate on the accuracy and significance of the obtained data. In doing so, standard measuring error does not exceed 5%.

RESULTS AND DISCUSSION: When weight of the movable part of the instrument is low, e.g. 0,0476 kg, this corresponding to the ratio $K \cdot m = 0,1$ H, value of limit tension of shift is elevated, which can be explained by heterogeneity of sausage meat. When load is small, full shift of the product does not take place and depth od indetor (penetrometer) immersion is somewhat lowered. Variation of readings is equal to 50%. The least readings variation is observed when $K \cdot m = 0,6$ H, this corresponding to mass 0,2857 kg and being on the average not more than 7% for sausage meat and 3-4% for pre-ground finished sausages.

For evaluation of sausage meat consistency needle penetrometers were used having one or 4 needles, as well as conic penetrometers with vertex angle 10°, 20°, 30°, 45°, 60°. Besides, conic penetrometers with smooth or knurled surface were used. Depth of knurls was 1 mm.

A cone with vertex angle 60° is the most rational solution ensuring minimum error, for sausage meat testing (initial or ground afterwards, when sample of finished sausage is taken for analysis), this being confirmed by other researches (Gorbatov A.V., 1973, Kosoj V.D. 1982, Machihin Yu. A., 1981).

The conducted tests using cones with smooth and knurled surfaces showed that determined values of limit tension of shift do not exceed ranges of experimental error.

For determination of finished sausages consistency a four-needle penetrator with vertex angle 10° was used. Experimental results showed, that it is possible to use both penetrators, standard error at this not exceeding 8%.

In order to improve accuracy of measurement and to obtain mean characteristics, finished sausage was ground through a 2 mm plate. Ground mass of sausage was firmly pressed in a mold (at a pressure of $4 \cdot 10^5$ Pa) before measurement, this mold having diameter 80 mm, which corresponded to surface area 5000 nm² with a 2 kg load. Preliminary pressing was done during

3 minutes.
It is known from scientific literature that immersion depth of penetration into sausage meat during 5 sec on the average constitutes 75% from maximum depth of penetration. In order to accelerate measurements of characteristics by which consistency of finished products or of sausage meat can be evaluated, the ratios of penetrations during 5 sec. or 180 sec. were revealed. For sausage meat (of cooked-smoked sausages) the ratio of depth values of pebetrators immersion constitute 1,3 with deviation up to 10% for sausage meat and 5% for supplementary minced sausage. For finished intact sausage items - 1,1 with error 7%, and for ground meat - 1,15 with error 4%.

CONCLUSIONS: Results of conducted research allow to recommend PMDP-1 instrument for technological process control and quality control of finished sausage products. Factors and level of their effect on significance and accuracy of obtained measurements were established.

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