Use of a penetrometer to determine firmness of emulsion-type sausages

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An instrumental method for determination of firmness of emulsion-type sausages is presented.

The sausages are sliced into 3 cm thick slices and temperated at 17°C. The firmness is measured with an "Instron Universal Testing Instrument" equipped with a small conical penetrometer.

Both the maximum force and the total work correlate well with sensory evaluation of firmness. The correlation coefficients are 0.93 and 0.92 respectively.

Some applications for the method are

- evaluation of formulas for sausages
- testing of food additives like soy protein, blood protein etc. in sausages
  routine quality control of sausages.

Die Benützung eines Penetrometers zur Festigkeitsbestimmung von Emulsionswürsten

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Eine instrumentäle Methode zur Festigkeitsbestimmung von Emulsionswürsten wird gezeigt.

Die Würste werden in 3 cm dicke Scheiben geteilt und auf eine Temperatur von 17°C gebracht. Die Festigkeit wird mit einem "Instron Universal Testing Instrument" gemessen, das mit einem kleinen konischen Penetrometers ausgerüstet ist.

Die maximale Kraft und die totale Arbeit stimmen gut mit der sensorischen Bewertung der Festigkeit übereins. Die Verhältniskoeffizienten betragen jeweils 0,93 und 0,92.

Einige Anwendungsgebiete für diese Methode sind

- Bewertung von Wurstrezepten,
- Untersuchung von Nahrungsmittelzusätzen wie Sojaprotein, Blutprotein u.s.w. in Würsten,
- Routinequalitätskontrolle von Würsten.

5.14

Usage d'un appareil pénétromètre pour déterminer la consistance des saucissons de type d'émulsion

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Une méthode instrumentale pour la détermination de la consistance des saucissons de type d'émulsion est présentée.

Les saucissons sont tranchés en des pièces de 3 cm d'epaisseur et ils sont tempérés à 17°C. La consistance est mesurée avec un "Instron Universal Testing Instrument" qui est équipé d'un petit appareil pénétromètre en forme de cône.

La force maximum ainsi que le travail total se trouvent en corrélation avantageuse avec l'évaluation sensoriale de la consistance. Les coefficients de corrélation sont 0,93 et 0,92, respectivement.

Quelques-unes des applications de la méthode sont

- l'évaluation des recettes pour des saucissons
- l'essai des additions alimentaires comme de la protéine de soja, de la protéine de sang etc. dans des saucissons
- le contrôle routinier de la qualité des saucissons.

Применение пенетрометра для определения плотности колбас эмульсионного типа

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Инструментальный метод для исследования плотности колбас эмульсионного типа

Колбасы нарезаются ломтями 3 см. толщины и подогреваются до 17°Ц. Плотность измеряется при помощи " Инстрон Юниверсл Тестинг Инструмент "[1)], снабженного небольшим конусообразным пентометром.

Максимальная сила и общее усилие находятся в хорошем соответствии с оценкой плотности на ощупь. Коэффициенты корреляции 0,93 и соотв. 0,92.

Некоторые области применения этого метода:
- оценка формул для колбас
- испытание добавок к пищевым продуктам как напр. соевого белка, кровяного белка и т.д. для колбас.
- текущая проверка качеств колбасы.

1/ Instron Universal Testing Instrument

5.14

USE OF A PENETROMETER TO DETERMINE FIRMNESS OF EMULSION-TYPE SAUSAGES

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INTRODUCTION

One of the fundamental quality properties of emulsion-type sausages is their firmness. Firmness can be determined by sensory or instrumental methods.

Since the products are intended for human consumption, sensory panel evaluation of firmness must be the most correct method. However, when using a panel a number of problems arise. To make it possible to compare results which are obtained at different times, firmness has to be expressed as an absolute value. For emulsion-type products this is difficult to achieve with a sensory panel, because it is hardly possible to produce a reference-sausage with constant firmness to which the panel can relate their judgements. In sensory analysis many people are involved, which makes the method expensive, especially when the number of samples is large.

An instrumental method does not have these drawbacks. Strictly specified conditions make the firmness values absolute and comparisons between results can be made independently of the elapsed time between the measurements. The instrument can be handled by one person which makes the method cheap.

To be meaningful the instrumental values must correlate well with sensory panel evaluation of firmness. This means that to decide if an instrumental method is applicable one must at first have a working sensory method.

The aim of this work was to develop a simple instrumental method for determination of firmness in emulsion-type sausages. We have not made any efforts to explain the rheological properties of this type of sausage.

MATERIALS AND METHODS

The sausages are cut into 3 cm thick slices. The slices are wrapped in aluminium foil and are equilibrated at 17°C. To make it easy to get exactly 3 cm thick slices with parallell surfaces we have made a special knife out of two ordinary knives (figure 1). It may be difficult to obtain a temperature of 17°C because it is near the ambient temperature. We have found that a cooled incubator, a combined heater and refrigerator, is well suited for this purpose.

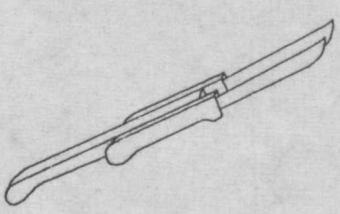

Figure 1

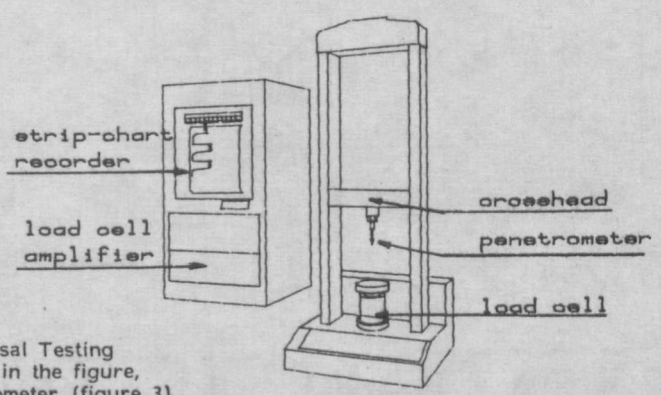

Figure 2

For the measurements we used an Instron Universal Testing Instrument (figure 2). An integrator, not shown in the figure, was connected to the instrument. A small penetrometer (figure 3) was mounted to the crosshead. The load cell with maximum load capacity 2000 g was used in the range 0 - 1000 g.

The equilibrated sample is placed on the load cell. The crosshead with the penetrometer moves downwards with a constant speed of 10 cm/min. When the tip of the penetrometer is 2 mm above the load cell the crosshead stops and returns to its upper position. During the downward movement when the penetrometer is pressed through the sample, the force is recorded on the stripchart recorder. The work is indicated digitally on the integrator.

Firmness was judged by an expert panel of 11 members. The used scale was a 100 mm long line where the left end point corresponded to soft and the right end point to firm. The distance, in mm, from the left end point to the mark was used as the score.

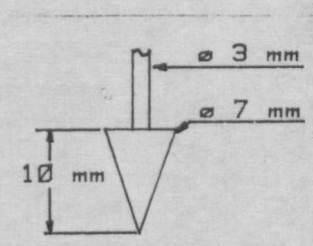

Figure 3

RESULTS AND DISCUSSION

To obtain sausages with firmness ranging from very soft to very firm we made products with varying protein percentages. Outgoing from a basic formula with a low meat content we changed the protein percentage by adding increasing amounts of meat or soy protein. Further details about the products are given in the appendix.

The maximum force is read from the time-force diagrams on the strip-chart recorder (figure 4). The total work is given in counts on the integrator. To make the calculations simple we did not transform the counts into work-units.

The force and work range from 150 (ponds resp. counts) for soft sausages to about 500 for firm sausages. The standard deviations are 25 ponds and 30 counts respectively. With 10 penetrations on each sample the smallest detectable differences are 25 ponds resp. 27 counts.

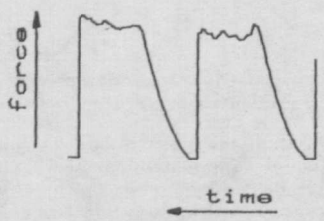

Figure 4

The correlations between sensory scores and instrumental values are shown in figures 5 and 6. The correlation coefficients are 0,931 for the relation between sensory scores and maximum force and 0.922 between sensory scores and total work.

In figure 7 it is shown that there is a very high correlation between the two instrumental values. The correlation coefficient is 0.981.

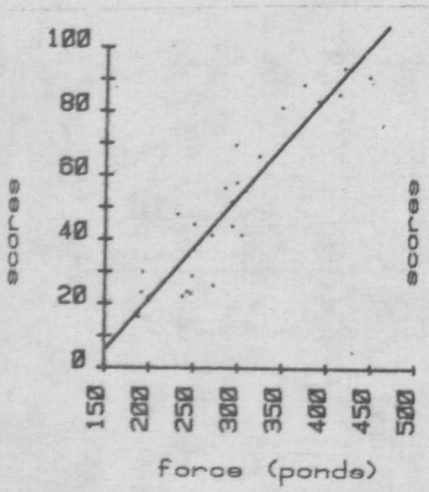

Figure 5

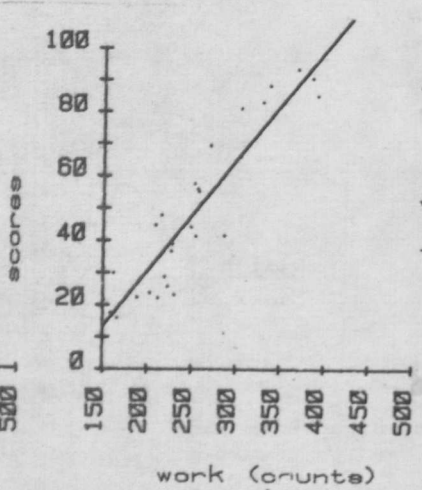

Figure 6

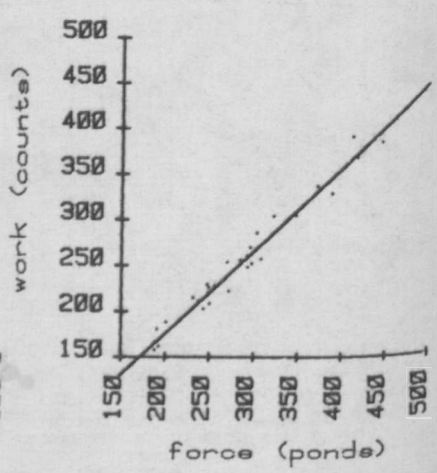

Figure 7

During evaluation of formulas for sausages this method makes it easy to detect variations in firmness due to changes in emulsion composition or changes in the cooking process.

Many sausages contain food additives like milk, soy or blood proteins. By addition of increasing amounts of the proteins to a standard emulsion formula the effect upon firmness in sausages may be studied.

In routine quality control the instrumental values can be used in control charts like $\bar{x}$-charts for the mean and R-charts for the range.

APPENDIX

Basic formula

Beef III (water 60%, fat 22%, protein 17%)	1148 g
Pork II (water 60%, fat 24%, protein 16%)	574 g
Backfat without rind	1129 g
Raw rind	264 g
Potatoe flour	230 g
Nitrite salt	75 g
Spices	12 g
Water	2468 g
	6000 g

Outgoing from this formula the other formulas contained additional meat or soy protein. After the additions the formulas were adjusted to constant fat and water amounts.

Chemical composition of the emulsions

	Basic formula	Increasing amount of meat protein				
Water (%)	65.7	65.1	64.4	63.8	63.4	62.6
Fat (%)	22.3	22.2	22.2	22.1	21.9	21.9
Protein (%)	7.1	7.6	8.1	8.6	9.1	9.6

	Basic formula	Increasing amount of soy protein				
Water (%)	65.7	65.4	65.0	64.7	64.4	64.0
Fat (%)	22.3	22.2	22.0	21.9	21.8	21.7
Protein (%)	7.1	7.5	8.0	8.4	8.9	9.3

The emulsions were made in a 20 l chopper.

Smoking and cooking

	Time (min.)	Dry temperature (^{o}C)	Rh (%)	
Pre ripening	30	65	50	
Smoking	30	70	50	
Cooking	30	78	100	to centre temp. 73^{o}C
Cooling				
- water spray				to centre temp. 30^{o}C
- in air	overnight	4		