OPTIMIZATION OF MEAT MINCING PROCESSES

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Introduction

Meat mincers are one of the most important machines in meat industry. The advantage of mincers are their continous working conditions. On the other hand by this kind of meat destruction we have some negative influences on the technological properties of meat. There are studies about different ways to increase the capacity and efficiency of mincers /1/, to improve the chopping quality /2/ or to increase the stability of knifes and plates /3/. Some machine developments from the last years showed that the mincing method is a possible way to produce meat batters /4/. Usual are diameters of drill-holes in the last plate up to 0.6 mm.
Every technical component of the mincing machine has a specific technological function. The screw is responsible for the transportation of the meat material to the mincing system and for building up a specific pressure. In the interior of the mincing system (the specific combination of knifes and plates) the pressure must be balanced. It's absolutely necessary to exclude pliability of the plates. Nevertheless the usual construction of mincing systems shows some problems to guarantee a good quality of cutting without smearing.
Normally industrial meat mincers work with a five or seven part mincing (cutting) system. The most important prerequisite for high efficiency of the mincer and a low level of raw material stress is the equality of resistance from plate to raw material in every cutting plane. Only by this way it is possible to realise a high efficiency of the mincer and a low energy consumtion.
The aim of this work is to measure the throughput of different meat materials in meat mincers with different drill holes in the last plate. Basing on this we would like to give scientifically examined proposals for a better compostion of mincing systems and other machine elements in a meat mincer.

Materials and Methods

The measurements were realised under industrial conditions in a meat mincer for fresh meat. The diameter of the plates was 300 mm. The number of revolutions of the screw was adjusted constant at 220 per minute. In the first experiments precutted cattle flanks (16 mm) were used as raw material– results in figure 3. Therefore a 2-part mincing system (only knife and plate) was applicated. The diameter of the drill holes was 2.4mm. The influence of the number of drill holes in the plate, the form of knifes and the width of plate on the throughput of the meat mincer was measured.

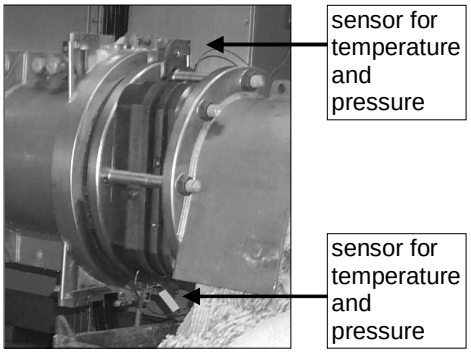

figure 1: experimental mincing system on work

In a second series of experiments measurements on more-part mincing systems, on varying diameters of drill holes in the last plate and on different kinds of meat were conducted. The basis for meat classification was the german system "GEHA" /5/. Basing on premeasurements the opened area of the plates was adjusted by the construction of the plates leading to equality of resistance from plate to raw material in every cutting plane (constructed by POWER TOOLS Germany). This is necessary to exclude an increase of pressure and temperature and to guarantee a good cutting quality. The principle construction of the experimental mincing system is showed in figure 1. The presented througputs are the mean values of 50 t minced meat for every experiment.

Results & Discussion

The results in figure 2 show the wellknown fact, an increasing number of drill holes in the plate there is followed by a specific increase of throughput. By increasing the number of wings in the rotary knifes it is possible to

increase the number of mincing cycles per revolution of the screw and the throughput of the mincer. The same effect can be seen for the width of the plate. The explanation for this result is a lower degree of bending (pliability) The necessary rebuilt of pressure after every cut can be realised by this way.
The results in figure 3 show at firstthat the througput of the mincer is increasing with increase the diameter of the drill holes in the last plate. Secondly, there is an overproportional growth of absolute throughput by increasing the number of cutting planes in the mincer. The increase of througput for last plates with a small diameter of drill holes is particular high (figure 4). The results in figure 5 show that the tendencies, valid for mincing systems with up to 3 cutting planes, are also valid for mincing systems with up to 4 cutting planes. Furthermore, the results shows that the absolute throughput of a meat mincer depends in a high level on the composition and structure of the minced meat material.

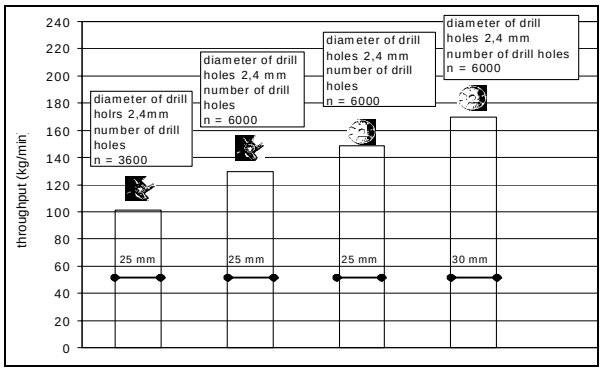

figure 2: throughput of meat mincers in demand of number of drill holes, width of plate and construction of knife for a 2-part mincing system

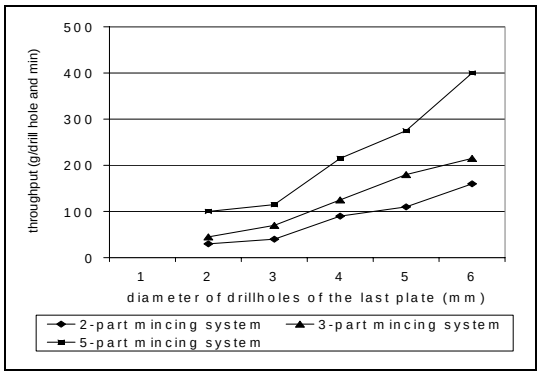

Figure 3: specific througput of meat mincers as a function of composition of the mincing system and the diameter of the drill holes in the last plate

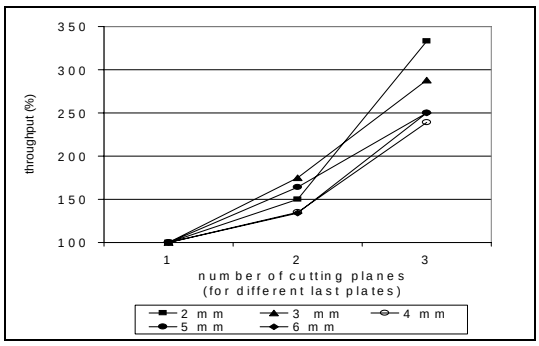

figure 4: increase of througput in meat mincers as a function of the number of cutting planes and the diameter of drill holes in the last plate

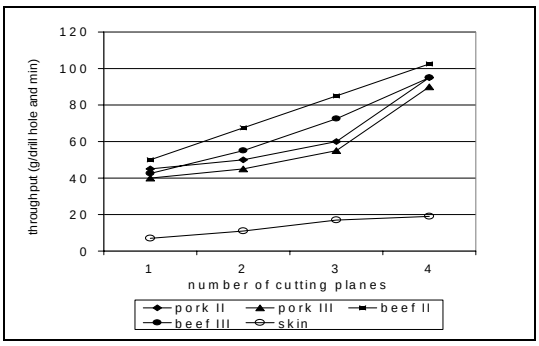

figure 5: througput of meat mincers as a function of the specific minced raw material and the number of cutting planes in the mincer

Conclusions

The composition of the mincing system in meat mincers must be adapted to the properties of the raw material. At first it concerns the number of cutting planes in the mincer. The througput of meat mincers for constant revolutions of the screw can be increased by increasing the number of drill holes in the plates, the number of cutting planes in the mincing system and by a specific construction of the knifes. By a specific construction of knifes an increase of the number of cutting cycles per revolution of the screw becomes possible.

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