PRESENCE OF STYRENE IN THE FLESH OF PIGS GROWN IN PIG HOUSES HAVING FLOORS MADE OF MODIFIED WOOD ("LIGNOMER")

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SUMMARY

Material being used for making floor in the pig house are often of inadequate quality. For that reason losses are observed in the pig production due to diseases, mortality and poor weight gain. Modified wood, subjected to thermal polymerisation of styrene monomers and used for the construction of floor in the pig house might be hazardous because of a direct contact of the chemically treated wood with the animals.

Experiments were conducted on 300 hogs, of this number one half was the control group (C). The other half - the experimental group, was grown in boxes with "lignomer" floor (D). All animals were kept in the same pig house and were given the same feed. From each group of 150 animals, seventy five were slaughtered at the live weight of 110 kg, and the other seventy five at the live weight of 140 kg. The muscle tissue and fat tissue from various parts of carcase were analysed for possible retention of styrene monomers. The presence of styrene monomers in the muscle and fat tissue was examined by the chromatografic technique (gas chromatograph type N-503 with flame ionization detector FID and with the column filled with DC-200 on Akron ABS).

The odour of styrene in the pig house was perceptible by nose. The bristles and skin of the pigs from the experimental group D demonstrated an intense yellow colour. In the muscle tissue and particularly in the fat tissue the presence of styrene was found in the animals of 110 kg slaughter weight as well as in those of heavier slaughter weight. The quantities of styrene varied greatly from 0.00 to 0.184 mg/100g in the muscle tissue and to 0.730 mg/100 g in the fat tissue. The sanitary regulations do not permit any traces of styrene in the animal raw materials.

The experimental results indicate that the modified wood has to be used in the pig house with great caution since the volatile monomers are harmful to the environment.

Introduction

Materials used in piggeries for full or slated flooring are often quite inappropriate. In general, such materials should be characterized by, among others, good resistance against breaking, abrasion, cracking; they should have low thermal conductivity, exhibit acid and base resistance, poor adherence of animal faeces and have no influence on the quality of meat and fat. All types of materials (concrete, bricks, wood, plastic) used for this purpose so far have not fully met the requirements of pig rearing. This leads to considerable losses in swine production due to diseases, deaths, poor weight gains which depend, in at least 50%, on environmental conditions.

A new technology has been worked out (Lawniczak 1971, 1984, 1991) which allows to obtain polymerized wood. It is based on thermal polymerization of wood styrene monomers using catalytic agents, pressure and oil as a thermal agent. During the polymerization process occurs a partially stable binding between the natural wood as a polymeric compounds and the synthetic polymer. Free spaces and pores in wood structure are filled giving a new wood - polymer composition. The obtained material is more resistant to bending and abrasion and is less absorbable. Thermal properties of polymerized wood are very similar to straw litter. The above mentioned properties of the lignomer resulted in its widespread use for the construction of floors in piggeries and calf sheds (Lawniczak 1974).

Initial observations of the applied lignomer in buildings for farm animals raised some fears whether the styrene monomer will not find its way into the meat and fat raw material. Its presence in food products is unacceptable.

It was, therefore, decided to carry out investigations concerning:

- animal salubrity and fattening results of pigs kept in pens with floors made of polymerized wood,
- the question whether the extended contact of animals with the lignomer will not result in the transfer of the styrene into animal tissues.

Material and methods

Experiments comprised 300 pigs which were divided into two groups; half of the animals were the control (C) group and the other half, kept in boxes with floor made of lignomer, were the experimental group (D). All the animals were kept in the same piggery and were fed in the same manner. Half of the animals from each group were slaughtered after reaching pre-
slaughter weight of 110 kg and the remaining animals were slaughtered at the weight of 140 kg 35 carcasses from each group of animals were subjected to chemical analyses.
Observations carried out during fattening concerned the behaviour of animals in pens their preferences for the position in the lie, their salubrity and live weight gains. After slaughter the slaughter yield and the presence of styrene in the muscle and fat tissue as well as in liver and kidneys were determined. Furthermore, lymph nodes, liver, kidneys, spleen, lungs and heart underwent detailed examination by the veterinary surgeon after slaughter.
The presence of styrene in the selected parts of the carcass was determined using gas chromatography type N 503 with a flame ionization detector PJD and a column filled with DC 200 on ABS akron.

The qualitative presence of styrene in the tissue was determined by inducing a colour reaction in the meat extract using carbon tetrachloride subjected to nitration.

Organoleptic evaluation of the smell of thermally processed meat and fat was also performed.

Results and discussion

First observations of this experiment allowed to conclude that the pen floor made of chemically hardened wood filled the piggery with a delicate smell of styrene. Moreover, it was observed that the bristle of swines from the experimental group had, with the exception of 3 animals, a darker reddish yellow hue.

Measurements carried out during the course of fattening showed that daily live weight gains were similar in both groups of animals, i.e. those kept on chemically hardened wood floors and those kept on concrete (Tab.2). Also the slaughter yield in both animal groups did not differ significantly (Tab. 2).

Significant differences were observed only in the veterinary evaluation of carcasses after the slaughter of animals. Approximately 51.4% of animals from group (C) with concrete floor and straw litter in their pens showed changes indicating past diseases during fattening. Lung and pleura inflammation, joint inflammation and TB were among the most
commonly detected diseases. Much lower incidence (7.5%) of past diseases was observed, in animals kept in pens with the lignomer flooring (Fig. 1). The phenomenon well known to swine growers of pigs lying in the warmest places in the pen was also observed in this group. They preferred placed covered with the lignomer. This probably explains the lower disease incidence in the experimental (D) group of animals.

Chemical analysis of the muscle and fat tissue as well as of the examined internal organs was to have demonstrated the possible occurrence of styrene in them. Its presence was found only in the tissue of experimental animals (D). The concentration of this compound varied from trace amounts up to 0.73 mg/100 g (Tab. 1). In ham muscles styrene content ranged from 0.008 to 0.184 mg/100 g, while in the m. longissimus dorsi it was detectable only organoleptically during the thermal treatment of the samples.
The highest concentration of styrene was ascertained in the subcutaneous fat of ham (from 0.02 - 0.72 mg/100 g). Styrene was detected also in kidneys and liver of animals from group D. Many of these organs were assessed as unacceptable or at least suspicious for consumption because of changes observed in them. The comparison of styrene concentration in the muscles of swines of different preslaughter weight and swines which spent different amounts of time in pens with floors with modified wood did not reveal significant differences. In the case of the pig which died during the experiment, chemical analysis showed presence of the following amounts of styrene in all the examined carcass tissues:

- in abdominal part of muscle tissues - 0.36 mg/100 g
- in abdominal subcutaneous fat tissue - 0.22 mg/100 g
- in back fat - 0.33 mg/100 g
- in m. longissimus dorsi - 0.43 mg/100 g

- in ham muscles - 0.44 mg/100 g

It is evident from the above that floors made of polymerized wood are undoubtedly warmer than floors made of concrete. They protect animals, especially young ones, against effects of colds. However, the presence of styrene in muscles and fat tissue, even in trace amounts, rules out the possibility of application of chemically modified wood in animal pens.

There may have been two causes for the presence of styrene smell in the piggery: either the wood was improperly polymerized or it underwent depolymerization under the influence of faesces and urine. If the former were the case, then improvement of the technological process would not exclude the application of such wood for floors in pens. However, if the latter were true, then the use of wood modified in this way as the material to be apllied in buildings for animals should be prohibitted.

Conclusions

1. The use of floors made of lignomer reduces the incidence of diseases in fattened swines.
2. No differences in daily live weight gains and dressing percentage were observed between pigs kept on concrete floors and floors from chemically hardened wood.
3. The meat and fat raw material obtained from pigs kept on lignomer floors contained styrene so it cannot be used for consumption.
4. No significant differences were observed in the amount of styrene in muscles in relation to the weight of slaughtered animals or the duration of contact of animals with the floor made of lignomer.
5. The smell of styrene observed in the piggery may have come either from not fully polymerized wood or from its depolymerization caused by faeces and urine.

References

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Table 1. Level of styrene in the examined muscles and fat of swine (mean values in mg/100 g)

Table 2. Rearing results of examined swines (mean values)

Figure 1. Diseases incidence in experimental groups of pigs