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**Assessment of the possibility of using essential oils to reduce microbiota in selected products made of minced meat**

**Summary**

The study aimed to evaluate the possibility of using essential oils to inhibit microbiota growth in heat-treated products made of minced meat. In the first stage, the values of the minimum inhibitory concentrations (MIC) of ten essential oils in relation to selected bacteria were determined. Then the influence of the most effective five on sensory characteristics and the level of microbial contamination in minced meat products was assessed.

The first part of the study determined the minimum inhibitory concentration for ten essential oils extracted from basil**,** black cumin, savory, clove, marjoram, curly mint, peppermint, rosemary, sage and thyme. Both Gram + and Gram- bacteria, which are often microbiological contaminants of raw materials and food products, were used in the research. Minimum inhibitory concentration (MIC) values were determined by serial two-fold dilution in Mueller Hinton II Broth using 96-well titer plates. A 0.01% resazurin solution was used as an indicator of bacterial growth, which was reduced by live bacterial cells, changing its colour from blue to pink. The lowest concentration of essential oil to prevent colour change was taken as the MIC value.

The results of the study showed that essential oils inhibit the growth of microorganisms, and their effectiveness depends on the type and concentration of the essential oil and the sensitivity of individual bacteria. The essential oils of basil, black cumin, savoury, marjoram and thyme were outstanding in inhibiting microbial growth. The studies found that savoury essential oil inhibited the growth of eight out of twelve tested bacteria at a concentration lower than the other essential oils. In addition, the results of the study showed that *Enterococcus faecalis* was the least sensitive bacterium to the inhibitory effect of essential oils, while *Klebsiella pneumoniae* was the most sensitive bacterium.

Based on the results from the first part of the study, five oils, the most effective in inhibiting the growth of bacteria, were selected for further research. These oils were added to two types of minced meat (pork ham and chicken fillet). Organoleptic and microbiological tests were carried out on the prepared material. Three types of meatballs were produced, in which the concentration of essential oils was: 0.1 mg / g, 0.5 mg / g and 1 mg / g. The control sample was meatballs without the addition of oils.

The sensory test took place on the day the meatballs were produced and was carried out by a six-person research team in accordance with Polish Standards. The intensity and desirability of smell and taste sensations were determined during the sensory analysis. In order to determine the effect of essential oils on microbiota growth, the total number of microorganisms and the number of psychrotrophic microorganisms were determined. These tests were carried out on the day of making the meatballs and on the third and sixth days of refrigerated storage at 4°C. These tests were performed according to the Polish Standards.

The results of the study showed that essential oils have a significant impact on the sensory properties of meat products. The type of meat and the sensory characteristics associated with it affect the acceptance level of the addition of essential oil. The sensory characteristics of pork with the addition of essential oils had a better assessment compared to poultry meat. The use of some essential oils in too high a concentration results in the lack of acceptance of sensory features.

The tests of the smell and taste of meatballs made of both poultry and pork showed the lowest intensity of these features in balls with the addition of black cumin oil and the highest intensity of savory. The highest desirability of smell and taste was found in balls with the addition of black cumin essential oil, and the lowest in balls with the addition of savory essential oil.

Based on the study, it can be concluded that essential oils inhibit the growth of microorganisms present in meat products; however, their impact depends on the type of oil and the concentration used. When assessing the effect of the concentration of essential oils on the number of microorganisms in the examined meatballs, no significant differences were found in the total number of microorganisms and the number of psychrotrophic microorganisms on the day of their production (day zero) and after three days of refrigerated and storage of the balls. A significant effect of the concentration of essential oils on the level of total bacterial contamination in meatballs was found only after six days of refrigerated storage. A significant effect of basil, savoury, marjoram and thyme oil was demonstrated in poultry products.

However, in the case of meatballs made of pork, significant differences were found only in balls with the addition of savory oil. There was no significant effect of the essential oils used on the number of psychrotrophic microorganisms in pork meatballs and in the case of products made of poultry meat. Only the concentration of savory essential oil significantly affected the number of these bacteria on the sixth day of refrigerated storage.

Selected essential oils inhibit microbiota growth in food of animal origin; however, their use in meat products requires the determination of an appropriate concentration that provides an inhibitory effect on the growth of microorganisms and, at the same time, will be sensory accepted.