

Summary and keywords

Since the last decade of the 20th century, there has been a significant increase in honeybee colony losses. This phenomenon, first observed in America, is known as colony collapse disorder (CCD), while in Europe, it is referred to as colony depopulation syndrome (CDS). The causes of CCD/CDS are believed to include biological factors such as pathogens (bacteria, viruses, fungi, the *Varroa destructor* mite, and protozoa), as well as anthropogenic factors like environmental pollution due to agricultural chemicals (neonicotinoids) and industrial development, monoculture farming, and the reduction of bee food resources in the environment. This unexplained phenomenon primarily affects worker bees. In the face of numerous threats, additional stress caused by the use of contaminated wax of unknown origin and unverified quality further complicates bee survival.

In light of the above, the aim of this doctoral dissertation was to test the impact of wax foundation contamination with stearin and paraffin on individual development and selected parameters of humoral immunity in the hemolymph of worker honeybees.

The experiments used wax foundation with the addition of stearin and paraffin in ratios of 10%, 30%, and 50% to pure wax. Seven types of foundation were made, each in three replicates. The foundation was placed into frames and introduced into colonies for comb building. In the apiary part of the experiment, the efficiency of brood rearing and queen cell larvae was assessed based on photographs. In the laboratory part, hemolymph was collected, followed by biochemical analyses to determine: total protein concentration, protease activity and their inhibitors, phenoloxidase activity, lysozyme activity, antioxidant enzyme activity, and the activity of selected non-enzymatic biomarkers. The morphological appearance and activity of hypopharyngeal glands and royal jelly were also analyzed.

The results of behavioral studies and laboratory experiments showed similar trends. The experiments demonstrated: lower brood survival, lower queen larva survival, less developed hypopharyngeal glands, changes in the properties of royal jelly, lower total protein concentrations, mostly lower activities of proteases and protease inhibitors, lower phenoloxidase activities, higher lysozyme activities, lower activities of all antioxidant enzymes, lower vitellogenin concentrations, and lower concentrations of non-enzymatic biomarkers in the experimental groups compared to the control group. In all cases, a greater decline in the activities/concentrations of the studied biochemical parameters in bees was observed in the groups with the addition of stearin than paraffin.

The results of the conducted experiments confirm that paraffin, and in particular stearin, should not be used for the production production of wax foundations, as they cause a number of irreversible and adverse effects, starting from changes in the physicochemical properties of the foundation, through changes in the number of emerged brood, to changes in the activity of enzymes crucial for bee immunity. Moreover, the adulteration of wax foundation with stearin and paraffin should be officially recognized as a previously unconsidered factor that may contribute to CCD/CDS.

Keywords: stearin, paraffin, *A. mellifera*, hemolymph, humoral immunity, antioxidants, hypopharyngeal glands, royal jelly.

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