

# Influence of Essential Oils on Queen Prolificacy and Bee Colony Health

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## Abstract

Essential oils obtained from medicinal and aromatic plants, due to their bioactive principles, represent an important pharmaceutical source for human and animals. The objective of this paperwork was to determine the effect of the addition in supplementary feeding of bee colonies of oregano and basil essential oils. The bee colonies fed, during spring, on sugar syrup and essential oils presented a better development, recording a number of bee brood cells that was bigger than in the control variant. At the same time, we observed a significant reduction in the total number of germs within the small intestine in the case of supplementation with these essential oils, correlated with the improvement of health status of bee colonies.

**Keywords:** essential oils, bees, antimicrobial properties

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## 1. Introduction

Medicinal and aromatic plants represent an important pharmaceutical source; more than 9000 plants with healing properties have been identified so far [1]. The utilization of medicinal and aromatic plants in the stimulating feeding of bee families, as extracts, tea or fresh juice, revealed the positive action exerted by these on bee bioproductive indices and health status [2]. The vegetal essential oils have a complex composition, influenced by the origin plant species, their maturation phase, by the geographic area, environmental conditions, and also by the method of extraction applied. They contain between 20 and 60 bioactive principles [3] with a strong bacteriostatic, bactericidal [4] and also antifungal activity [5, 6].

The essential oregano oil (*Origanum vulgare*) contains mainly carvacrol,  $\beta$ -fenchyl alcohol, thymol, and  $\gamma$ -terpinene [7] with a strong antimicrobial, antiviral and antifungal action [8]. The main components of essential basil oil

(*Ocimum basilicum*) are represented by methyl eugenol and methyl chavicol, which confer strong antimicrobial properties [9].

The objective of this paperwork was to determine the effect exerted by essential oregano and basil oils on the development of bee colonies during spring and the antimicrobial effect exerted on the total number of germs within the working bee intestine.

## 2. Material and methods

The researches were carried out on 18 *Apis mellifera carpatica* bee colonies, maintained in Dadant and multi-layered beehives, distributed in three experimental variants. The bee families presented a similar development level, and queens of the same age. The experiments were performed in the apiary belonging to the Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael 1st of Romania" from Timisoara, Romania, in the period 30.03.2018 – 20.04.2018, according to the scheme presented in table 1.

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**Table 1.** Experimental organization scheme and amounts of preparations offered

No.	Experimental variants	Feed structure		
		Sugar syrup (l)	Essential oregano oil	Essential basil oil
1.	Control variant (M)	1	-	-
2.	Experimental variant 1	1	2 drops	-
3.	Experimental variant 2	1	-	2 drops

The bee colonies were offered weekly, for three weeks, in feeders disposed on beehive loft, 2 l sugar syrup 1:1. In the case of the batch LE<sub>1</sub>, we incorporated two drops of essential oregano oil/1 syrup, and in the case of LE<sub>2</sub>, two drops of essential basil oil/1 syrup.

To find out the effect exerted by the influence of essential oils on queen prolificacy, we determined, with the help of the Netz frame, the average number of cells with brood (capped and uncapped), at the beginning of the experiment and at 21 days of administration. At the beginning and at the end of the experiment, we sampled 10 working bees and submitted them to microbiological tests in order to establish the total number of germs present in the small intestine. The microbiological examination was carried out in concordance with the method described by [10]. The statistical interpretation of results was performed with the help of the Tukey test.

### Results and discussion

The utilization of essential oils in the feeding of bee families during spring led to the stimulation of queen reproduction. The number of brood cells recorded at the end of the experiment revealed that the bee batch fed on sugar syrup supplemented with 2 drops of essential oregano oil/1 l syrup, presented a number of brood cells that was bigger with 9434 compared with the control variant, at statistically significant differences ( $p < 0.001$ ) (table 2). The batch LE<sub>2</sub> fed on sugar syrup supplemented with two drops of essential basil oil /1 l syrup recorded a number of cells that was bigger with 7684 than in the control variant, at statistically significant differences ( $p < 0.01$ ), but smaller with 1750 cells than in the experimental batch 2, fed on syrup and oregano extract (table 2). Similar results were reported after the utilization of some essential oils by other researchers, as well [11, 12].

**Table 2.** The number of brood cells recorded in the bee colonies studied

No.	Indices	Experimental group					
		Control group		Experimental group 1		Experimental group 2	
		At the start of the experiment period	After 21 days	At the start of the experiment period	After 21 days	At the start of the experiment period	After 21 days
1	n	6	6	6	6	6	6
2	$\bar{x}$	8416.66	29466.66	8450	38900 <sup>***</sup>	8283.33	37150 <sup>**</sup>
3	$S_{\bar{x}}$	± 565.930	± 1207.660	± 493.119	± 348.329	± 808.049	± 863.230
4	S	1386.2419	2958.1525	1207.8907	853.2291	1979.3096	2114.473

\* $p < 0.001$ ; \*\* $p < 0.01$

From a microbiological perspective, the utilization of essential oils in the sugar syrup offered to bee families led to the reduction in the total number of pathogen germs at intestine level. The bee colonies belonging to the experimental groups recorded a total number of germs that was smaller with 25.46 % in the case of the group fed on essential oregano oil and with 4.58% in the case of

the group fed on essential basil oil, compared with the control variant, at statistically significant differences ( $p < 0.05$ ) (table 3). [13] proved the efficiency of essential oregano and basil oils in the prevention and control of the American Foulbrood disease. Other studies revealed the efficacy of some essential oils in the fight against the parasite *Varroa destructor* [12, 14].

**Table 3.** Total number of pathogen germs present in the intestine of the studied working bees

No.	Indices	Experimental group					
		Control group		Experimental group 1		Experimental group 2	
		At the start of the experiment period	After 21 days	At the start of the experiment period	After 21 days	At the start of the experiment period	After 21 days
1	n	6	6	6	6	6	6
2	$\bar{x}$	548.16	563.5	524.16	420.0*	587.5	537.66 <sup>ns</sup>
3	$S_{\bar{x}}$	± 28.995	± 29.808	± 68.024	± 37.357	± 35.212	± 49.858
4	S	71.0251	73.0143	166.6258	91.5073	86.2525	122.1288

ns-Statistically not significant; \*p<0.05

#### 4. Conclusions

1. The utilization of essential oregano oil in the sugar syrup offered to bee colonies during spring led to the stimulation of queen reproduction and to the reduction of the total number of pathogen germs at small intestine level. The bee colonies recorded a number of brood cells (capped and uncapped) that was 32.01% bigger than in the control variant, at statistically significant differences (p<0.001). This exerted a strong antimicrobial effect on the pathogen flora within the intestine, and the number of germs got significantly reduced in 3 weeks of administration (p<0.05).

2. The stimulating effect on queen reproduction was also observed in the case of the feeding of bee colonies with sugar syrup supplemented with essential basil oil. This was concretized in a number of brood cells that was 26.07% bigger, at statistically significant differences (p<0.01), compared with the control variant.

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