

# THE EFFECT OF FEEDING BEES ON THEIR VIABILITY AND EGG LAYING BY THE QUEEN BEES

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*The peculiarities of formation of productive qualities of bee families of Carpathian and Ukrainian steppe breeds under different conditions of wintering and use of honey plants, as well as different composition of fodder during autumn and spring feeding are established. It is proved that the productivity of bees and the quality of honey is positively affected by feeding them honey candy with the addition of quail eggs and sugar syrup with the addition of citric acid and a suspension of microalgae "Live Chlorella".*

**Keywords:** bees, feeding, development, stimulation, queen bee

**Introduction.** The productivity and survival of the bee family is influenced by such factors as: external - climate, weather, pathogens, enemies and pests of bees, human economic activity (including the use of pesticides, herbicides) and internal - the bee family, its strength, breed, line.

According to Bogdanov A.V. [1], Verigina I.P. [2], Papchenko O.V. [3] and others, increasing the number of bees in the family in the spring is extremely important in preparing it for pollination, use productive honey harvests, rebuilding of honeycombs, creation of large fodder stocks for the period of unfavorable weather in summer and winter, as well as in autumn for raising young bees, which will have to winter and raise several generations of bees in the spring of next year.

The growth of young bees for the winter depends on how intensively and for how long the queen bees will lay eggs during August and September. Derived from them bees retain the highest viability, they die a little in winter. After a cleaning flight in the spring, they can raise young bees, which gives impetus to prepare the family for the spring honey harvest [4, 5].

Increasing the number of bees in the family in the spring is extremely important in preparing it for pollination, the use of productive honey harvests, rebuilding hives, creating large forage reserves for adverse weather in summer and winter, as well as in autumn to increase young bees, which will have to winter and grow several generations of bees in the spring of next year [2, 3, 5].

The strength and development of bee colonies in the spring, especially those that weakened after the winter, is not sufficient for the effective use of the first honey harvest in Ukraine. One of the ways to effectively stimulate bee colonies to development is the use of carbohydrate and protein fertilizers. Therefore, the aim of the work was to study the development of bee colonies in the spring and summer with the use of top dressing.

**Materials and methods.** Materials were obtained as a result of observations and research conducted in 2014 - 2018 in the homestead apiaries of Mykolaiv, Odessa, Vinnytsia regions, as well as in the laboratory of technological and special measures for the prevention of bee diseases at the NSC "Institute of Beekeeping. P.I. Prokopovych "in Kyiv. The object of research were bee families of Ukrainian steppe and Carpathian breeds of bees. The priority in the research was the development of reliable technology through different types of feeding, improving the productive qualities of bee families of different breeds.

For the study, experimental and control groups of bees were formed by the method of selection of analogous families, identical in breed, age of the uterus, method of keeping, use of honey base. The peculiarities of the reproductive function of queen bees, the development of bee colonies after wintering and their productivity were determined, a comparative assessment was made during the period of egg laying by bee queens and brood rearing, development and productivity of bee colonies by different methods of their feeding.

To determine the effectiveness of different types of feeding bees were formed into four groups of families (table 1).

*Table 1*

**Scheme of spring stimulating feeding of bees**

Groups	Feeding composition
I – control	Sugar syrup (70%) (1 liter of water + 2 kg of sugar)
II – experimental	Sugar syrup (70%) with the addition of 2 g of citric acid
III – experimental	Honey candy with the addition of quail eggs (1 kg of honey dough + 3 quail eggs)
IV – experimental	Sugar syrup (70%) with the addition of a suspension of microalgae "Live Chlorella" (750 ml of syrup + 250 ml of suspension)

Group I - control, family care was carried out according to standard methods. After wintering, bee colonies were inspected, fed, and nests replenished by adding light honeycomb or light brown honeycombs.

Group II - experimental. Citric acid was added to sugar syrup, which consisted of one part water and two parts finely ground sugar).

Group III - experimental. Quail eggs were added to the honey dough at the rate of 3 eggs per 1 kg of dough.

Group IV - experimental. Sugar syrup with a suspension of microalgae "Live Chlorella" was served through a drink at the rate of 1 liter of suspension per family. Feeding of bees took place through drinking troughs.

Sugar syrup was given to bee colonies in the form of syrup in liter jars with special lids-feeders. Honey candy with quail eggs was made by hand, mixing in a bowl until a homogeneous mass of pleasant aroma and color. Bee colonies were given in the form of pancakes in gauze.

**Research results.** An important role in assessing bee colonies is an indicator of their winter hardiness. For the development of profitable beekeeping in the south of Ukraine, importance is attached to the study of winter hardiness of bee colonies, as their preservation in the winter depends on the spring development and productivity of the apiary. Therefore, we set ourselves the task of preparing only strong bee families for the winter. To do this, in late September and early October, increased in the experiment of young bees, through the use of different types of feeding. The survival of bees in winter depends on the hereditary characteristics of the bee family, its health, autumn bee growth, feed quality, breed and other factors. Studies have shown that both breeds have good indicators of survival after winter. Some differences were that Carpathian bees overwintered better in the winter, and Ukrainian steppe - in the wild.

According to results of the carried-out researches on winter hardiness of bees it is visible that at wintering in the Mykolaiv area of bee families of Carpathian breed on freedom at top-dressing with sugar syrup safety decreased by 10% on indicators of two years. When using quail eggs, the

preservation of both in the winter and in the wild had no significant differences, except for wintering in the wild in the period 2015-2016. The decrease in the survival of bee colonies in the wild during this period was 10% compared to the survival in the winter. Feeding bees with citric acid, contributed to their increased preservation in the wintering area by 10%.

In the Odessa region wintering of bees of Ukrainian steppe breed in the wild and wintering and feeding with sugar syrup and candy with quail eggs, the difference in their safety was not observed, and when using citric acid, the safety of bees in wintering was less by 10% in 2014- 2016

Also analyzing the data of wintering of bee families of Ukrainian breed in the wild and in the wintering ground on the first apiary, their safety was different. Thus, when kept in the wild and fed with sugar syrup, the preservation of bees in the wild is less than in the wintering area by 10% during the experimental periods. When fed quail eggs, the safety of bees kept free in the period 2014-2015 was the same, and in the period 2015-2017 was lower by 10%. When fed with citric acid, the survival of bees during the winter in the wild in 2014-2016 was lower by 10% compared to the winter in the winter. In the period 2016-2017, no significant differences in the preservation of bees depending on wintering conditions were observed.

In the second apiary, the difference in the conservation of bees in the wild for the period 2015-2016 was smaller by 10% compared to wintering in the winter. When feeding quail eggs, the difference was not observed. When fed with citric acid, the survival of bees in the wild by periods was lower by 10% compared with the content of bees in wintering grounds.

Regarding Vinnytsia region, the data show that the survival of bee families of the Carpathian breed in the winter of 2014-2015 was better when fed quail eggs and prevailed by 10% safety when fed sugar syrup and 5% when fed citric acid. A similar result was obtained during the winter of 2016-2017. The preservation of bee colonies was the same as the feeding of quail eggs and citric acid and the safety of bees feeding with sugar syrup prevailed by 5 - 10%.

Thus, for the better preservation of bee colonies, according to the results of research, there was feeding honey dough with quail eggs.

It was also established that the environmental conditions and feeding contributed to the largest number of breeding bees of the Carpathian breed with queens of the second year per family in the Mykolaiv region by 2506 pieces or 3.17%, and in the Vinnytsia region - by 1288 units or 2.95%.

The results of the studies indicate a different effect of the suspension of microalgae "Live Chlorella" on the productivity of bees. (Table 2-4).

*Table 2*

**Average daily laying of eggs by queen bees of the second year of hatching on apiaries of the Mykolaiv area, (n = 5), piece.**

Egg laying period, days of the month	Apiary		The ratio of II to I apiaries, %
	I	II	
	Feeding		
	Ss (70%)	Ss (70%) + Ch	
from 15.04. to 25.04	515±31.3	580±38.7	11,21
from 26.04 to 05.05	830±35.1	980±35.3	15,31
from 06.05 to 15.05	1685±32.9	1730±31.6	2,61
In average	1010±33.1	1096±35.2	9,71

Table 2 shows that for the first decade the average daily egg laying by the queen bees when fed with a suspension of microalgae "Live Chlorella" increases by 11,21%, for the second decade by 15.31%, and for the last study period by 2.61%. On average, the laying of eggs by the queen bees of the Carpathian breed for the studied periods is higher by 9,71%.

Table 3

**Average daily laying of eggs by queen bees of the second year of hatching on apiaries of the Odesa area, (n = 5), piece.**

Egg laying period, days of the month	Apiary		The ratio of II to I apiaries, %
	I	II	
	Feeding		
	Ss (70%)	Ss (70%) + Ch	
from 15.04. to 25.04	620±30.2	690±39.9	10.15
from 26.04 to 05.05	1100±34.7	1250±35.1	12.00
from 06.05 to 15.05	1910±31.9	2080±30.7	8.18
In average	1210±32.3	1340±35.2	10.11

Table 3 shows that for the first decade the average daily egg laying by the queen bees when fed with a suspension of microalgae "Live Chlorella" increases by 10.15%, for the second decade by 12.00%, and for the last study period by 8.18%. On average, the laying of eggs by the queen bees of the Carpathian breed for the studied periods is higher by 10.11%.

Table 4

**Average daily laying of eggs by queen bees of the second year of hatching on apiaries of the Vinnytsia area, (n = 5), piece.**

Egg laying period, days of the month	Apiary		The ratio of II to I apiaries, %
	I	II	
	Feeding		
	Ss (70%)	Ss (70%) + Ch	
from 15.04. to 25.04	695±32.6	710±37.9	2.12
from 26.04 to 05.05	1130±36.7	1310±35.4	13.75
from 06.05 to 15.05	1845±33.9	1905±36.1	3.15
In average	1223±34.4	1308±36.5	6.34

From table 4 it is seen that for the first decade the average daily egg laying by the queen bees when fed with a suspension of microalgae "Live Chlorella" increases by 2.12%, for the second decade by 13.75%, and for the last study period by 3.15%. On average, the laying of eggs by the queen bees of the Carpathian breed for the studied periods is higher by 6.34%.

Therefore, we can conclude that feeding bees with sugar syrup with a suspension of microalgae "Live Chlorella" in all studied apiaries on average increases egg laying by the queen

bees by 6.34%. Uteri of the Carpathian breed increase egg laying by an average of 202 pieces. or by 18.3%, Ukrainian steppe - by 230 pieces. or 20.4%

In the spring, bees need to develop normally before the start of the active period. Protein fertilizers are effective in early spring and late summer, especially when there is no pollen bribe and perga stocks in the hive. The absence of a natural bribe of protein feed allowed the queen bees to use a suspension of microalgae "Live Chlorella".

Chlorella contains more than 60% protein, so it served to accumulate protein feed and improve the condition of families after wintering and faster increase in family strength, as well as stimulate accelerated egg laying by queens.

The results of determining the rate of exposure to the suspension of microalgae "Live chlorella" and its effect on the life expectancy of bees are shown in table 4.

Table 4.

***Influence of feeding different concentrations of suspension of microalgae "Live chlorella" on life expectancy of bees (beginning of feeding 9.07)***

A variant of the experiment	Death of bees on the date of the experiment,%					
	9.07-15.07	16.07-22.07	23.07-29.07	30.07-5.08	6.08-12.08	13.08-19.08
Option 1. Control (keeping bees on the syrup cooked on tap water)	7,39	8,88	24,12 ±2,21	48,3	71,68	87,4
Option 2. Double feeding of the suspension of microalgae "Live Chlorella" in 10% concentration (keeping bees in syrup prepared in tap water)	10,12 ±3,13	11,51 ±3,88	25,6 ±6,86	41,61 ±4,37 *	53,98 ±4,65 *	70,4 ±0,32 **
Option 3. Double feeding of a suspension of microalgae "Live Chlorella" in 5% concentration (keeping bees in syrup prepared in tap water)	12,28 ±3,27	13,59 ±2,01 *	30,58 ±1,71 ***	43,47 ±2,76 ***	57,7 ±4,16 ***	71,94 ±3,50 ***
Option 4. Double feeding of the suspension of microalgae "Live Chlorella" in 1% concentration (keeping bees in syrup prepared in tap water)	5,07 ±1,53	8,79 ±1,38 *	25,4 ±3,35 *	35,72 ±6,38	51,77 ±8,87	64,22 ±11,13
Option 5. Double feeding of the deactivated suspension of microalgae "Live Chlorella" in 5% concentration (keeping bees on the syrup prepared on tap water)	4,18 ±1,12	7,21 ±2,84	26,56 ±6,65	44,04 ±8,24	51,69 ±8,84	64 ±8,17 *

Note. \* $p > 0,95$ ; \*\* $p > 0,99$ ; \*\*\* $p > 0,999$

Live chlorella microalgae suspension contains a wide range of micro-macronutrients, vitamins and a significant amount of protein. Therefore, its introduction into the feed for bee feeding enriches its protein and energy value.

The lifespan of flying bees with such feeding with the content of different concentrations of the suspension of microalgae "Live Chlorella" when kept in separate hives in a thermostat at a temperature of 34-35°C, is different.

The lowest mortality of flying bees was observed when fed with sugar syrup prepared in tap water with the addition of 1% suspension of microalgae "Living Chlorella" compared to higher concentrations in syrup.

Characteristically, the feeding of bees with sugar syrup with the same concentration of the suspension of the microalgae "Living Chlorella" bee mortality increased with increasing duration of the experiment. Thus, double feeding of the suspension of microalgae "Live Chlorella" 1% concentration in sugar syrup prepared on tap water mortality of flying bees increased from  $5.07 \pm 1.53\%$  in the first 7 days to  $64.22 \pm 11.13\%$  at the end experiment for 42 days. A similar trend of increasing bee mortality was in the variants of the experiment with a higher concentration of the suspension of microalgae "Live Chlorella". Thus, at the 5% concentration of the suspension of microalgae "Live Chlorella" the increase in mortality was from  $12.28 \pm 3.27$  to  $71.94\%$ , and the 10% concentration, respectively, from  $10.12 \pm 3.13$  to  $70.4 \pm 0.32\%$ .

This increase in the mortality of flying bees probably occurred because the protein - energy - enriched sugar syrup in the first half of the experiment helped to increase the viability of bees through active eating of food. Re-feeding of the same concentration of the suspension of microalgae "Live Chlorella" in sugar syrup led to the accumulation of protein in the body of bees. And since excessive protein nutrition leads to loss of appetite and reduced food intake, the bees began to eat less food without feeling hungry.

They became sluggish, passive, which contributed to the death of more of them. There was a natural selection. Stronger, stronger and more viable individuals survived. The higher mortality of bees was also facilitated by the short duration of the experiment, which was probably insufficient to adapt to the excessive intake of protein substances in their body. Mortality of flying bees was also observed at increased concentrations from 1 to 10% of the suspension of microalgae "Live Chlorella" in sugar syrup when feeding bees.

As a result, the body dies without feeling hungry. At the same time the strongest and viable individuals survive. Lower mortality of bees at feeding of the deactivated suspension of microalgae "Live chlorella" is caused by smaller activity of its components.

### **Conclusions**

1. Preservation of Carpathian bees after wintering in the wild when fed honey candy with the addition of quail eggs averaged 95.85%, sugar syrup with citric acid - 91.85%, sugar syrup - 85.4%, and wintering in the winter - 97.5, 95.85; 90.4% respectively.

2. It is revealed that feeding of bee families of Carpathian breed with suspension of microalgae "Live chlorella" on homestead apiaries increases average daily laying of eggs by a queen bees by 11.1% on average ( $P > 0.99$ ), in comparison with the Ukrainian steppe breed in the conditions of the Mykolaiv area, in Odesa oblast, in Ukrainian bee steppe breeds, these indicators were 11.3% ( $P > 0.99$ ), respectively, and in homestead apiaries of Vinnytsia oblast - by 7.1%.

3. The death of flying bees during two feedings of the suspension of microalgae "Live Chlorella" of 1% concentration with sugar syrup increases from  $5.07 \pm 1.53\%$  to  $64.22 \pm 11.13\%$  in 42 days, in 5% - from  $12.28 \pm 3.27\%$  to  $71.94\%$ , and 10% - from  $10.12 \pm 3.13\%$  to  $70.4 \pm 0.32\%$  ( $P > 0.999$ ).

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