Influence of fat additives of black soldier fly larvae (*Hermetia illucens*) larvae on the dynamics of microorganisms in model food systems

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Table 1. Black soldier fly larvae fat antimicrobial activity

Sample	Suppression zone diameter, mm			
	B. subtilis	S. aureus	E. coli	C.albicans
Bright fat fraction (BFF)	12,5±1,5	0	0	10,5±0,7
Directly pressed fat (DPF)	0	0	0	12,5±0,9
Dark fat fraction (DFF)	16,5±0,5	12,5±1,5	10,0±0,0	12,5±0,9
Protein fraction (PF)	10,0±0,3	0	0	0

The biologically active substances of larval fat have antimicrobial activity. Using the agar diffusion method, larval fat was found to inhibit the growth of *Bacillus subtilis, Staphylococcus aureus, Escerichia coli, Candida albicans.*

The antimicrobial properties of proteins and fats were evaluated by agar diffusion method. For the evaluation of the antimicrobial efficacy of the protein and fat fractions of black soldier fly larvae biomass, 10% ethanolic solutions of 4 submitted samples, (BFF, DPF, DFF, PF) were prepared.

Gram-positive cultures of *Bacillus subtilis*, *Staphylococcus aureus* and Gram-negative cultures of *Escerichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhimurium* and a culture of the pathogenic yeast *Candida albicans*, belonging to the microscopic fungi, were used for the tests.

The data obtained (Table 1) show that the bacteria are more strongly affected by DFF, with larger zones of inhibition, but the Gram-positive bacteria *Bacillus subtilis* and *Staphylococcus aureus* are more sensitive, with inhibition zones with diameters of 16.5±0.5 and 12.5±1.5 mm respectively. DPF is the least effective, while Gram-negative cultures of *Escerichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhimurium* proved to be resistant.

All three fat fractions inhibited the growth of the yeast *Candida albicans*, with inhibition zones of 10.5±0.7, 12.5±0.9 and 12.5±0.9 mm in diameter, respectively. The protein fraction solution has no antimicrobial properties and inhibits only one bacterium, *Bacillus subtilis*, with an inhibition zone diameter of 12,5±1,5 mm.

In model food systems with larval fat, the total number of microorganisms increases during storage at 5°C but a decrease in the number of microscopic fungi was observed. Therefore, the presence of larval fat in food systems not only optimizes the composition of fatty acids, but also protects against spoilage caused by microscopic fungi.

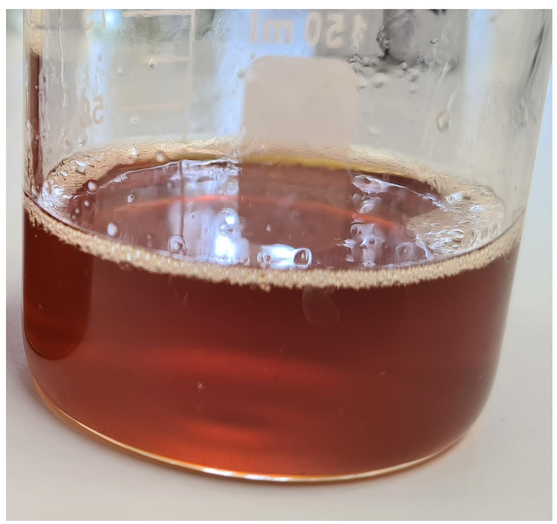

Fig. 1. Melted larvae fat (Directly pressed fraction)

Table 2. Black soldier fly larvae fat antimicrobial and antifungal activity in plant based food matrix

	$Sample_{30}$, 1st day	**$Sample_{30}$, 30th day**	**$Sample_{50}$, 1st day**	**$Sample_{50}$, 30th day**
Microorganism count, CFU/g	$8,8\times10^2$	$1,9\times10^7$	$1,6\times10^2$	$1,6\times10^6$
Coliform bacteria count, CFU/g	$7,0\times10^1$	$< 4,0\times10^1$	$< 1,0\times10^1$	$5,0\times10^1$
Total number of mesophilic lactic acid bacteria, CFU/g	$1,1\times10^2$	$< 1,0\times10^1$	$8,0\times10^1$	$< 1,0\times10^1$
Number of suspected bifidobacteria, CFU/g	$< 1,0\times10^1$	$< 1,0\times10^1$	$< 1,0\times10^1$	$< 1,0\times10^1$
Total number of sulphite-reducing bacteria (clostridia), CFU/g	$< 1,0\times10^1$	$< 1,0\times10^1$	$< 1,0\times10^1$	$< 1,0\times10^1$
Yeast count, CFU/g	$9,0\times10^1$	$2,2\times10^4$	$< 1,0\times10^1$	$3,4\times10^4$
Number of mould fungi, CFU/g	$1,1\times10^2$	$1,7\times10^2$	$4,7\times10^2$	$< 4,0\times10^1$

Sample $_{30}$ - 30% of all fat content in plant based food matrix was replaced with larvae fat; $Sample_{50}$ - 50% all fat content in plant based food matrix was replaced with larvae fat. Samples held at +5°C

The findings suggest that antimicrobial properties of black soldier fly larvae fat in food systems could improve microbiological safety and stability of microbiological parameters.