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IMPACT OF SUGAR SYRUPS ON LIFESPAN AND AGE RELATED PHYSIOLOGICAL CONDITION IN CAGED HONEYBEES

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Impact of sugar syrups on lifespan and age related physiological condition in caged honeybees

- The transition from nursing to foraging is known to be associated with *food perception, consumption etc*.
- Bees infected with *Nosema ceranae* have higher hunger level leading to a lower survival. Infected bees fed *ad libitum* and non-infected bees had similar lifespan.
- It is not known how **substitute energy sources**, such as ***sugar syrups***, *affect worker metabolism* including possible *influence of Nosema* spp. in the midgut, and *shorten the honeybee lifespan* according to season.

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VARIOUS CARBOHYDRATE SUPPLEMENTS

Fructose-glucose syrup

Saccharose-fructose glucose syrup

Fructose-glucose saccharose syrup

Saccharose syrup (white sugar + water)

Sugar candies

Fotos: Web

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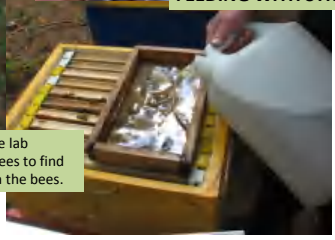
FIELD TRIALS, FEEDING WITH SYRUPS



At the same time we made lab experiments with caged bees to find out the effect of syrups on the bees.

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METHODOLOGY

We conducted a series of experiments using caged bees and commercially available syrups:

1. GLUCOSE – FRUCTOSE SYRUP (GF)
2. SACCHAROSE – GLUCOSE – FRUCTOSE SYRUP (SGF)
3. FRUCTOSE – GLUCOSE – SACCHAROSE SYRUP (FGS)
4. SACCHAROSE SYRUP (SS).

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METHODOLOGY

Newly-emerged honey bees (*A. m. carnica*, Poll.)			Feeding
1. Experiment	Spring bees (April-May 2012)		GF syrup SGF syrup FGS syrup SS, 60 % 4 repetitives, 100 bees
2. Experiment	Summer bees (June-July 2012)		Floral honey, beebread (1 cage)
3. Experiment	Winter bees (October-November 2012)		GF syrup, diluted 1:1 SGF syrup, diluted 1:1 FGS syrup, diluted 1:1 SS, 60 % 4 repetitives, 100 bees

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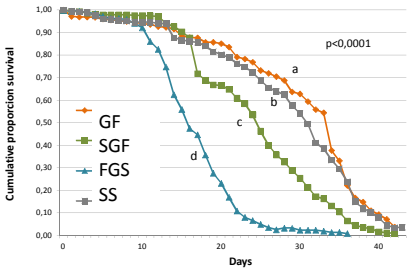
METHODOLOGY

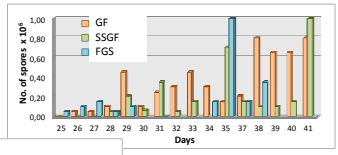
a) SURVIVAL –daily counted dead bees
b) NOSEMA SPORES – abdomens of dead bees, spores were counted using hemocytometer
c) TOTAL PROTEIN CONTENT IN HEMOLYMPH (according to Bradford)
d) VITELLOGENIN (SDS-PAGE electrophoresis)
e) GLUCOSE/FRUCTOSE TITRE IN HEMOLIMPH (HPLC)
f) VENTRICULUS (cell death – apoptosis)

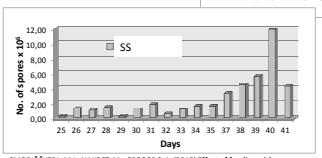
I. RESULTS: SPRING BEES - *SURVIVAL*



SMODIŠ ŠKERL, M.I., NAKRST, M., GREGORC, A. (2012) **Effect of feeding with sugar syrups on honeybee (Apis mellifera carnica) longevity**. V: ČEH, Tatjana (ur.). 21. mednarodno znanstveno posvetovanje o prehrani domačih živali, Zadravčevi-Erjavčevi dnevi 2012. *Zbornik predavanj: Zadravec-Erjavec Days 2012, Radenci, November 8th and 9th, 2012*. Murska Sobota, p 99-104.

I. RESULTS: *NOSEMA SPORES*

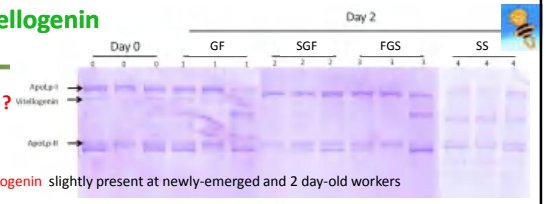




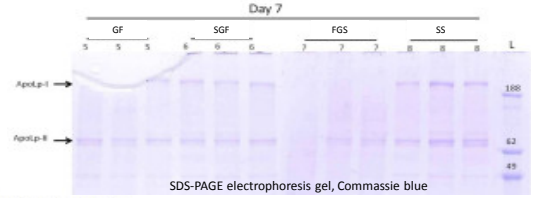
Sample sizes (n):
TruSweet: 3 - 31 bees
Apiinvert: 5 – 30 bees
Ambrosia: 1 – 7 bees
Sugar syrup: 4 – 35 bees

SMODIŠ ŠKERL, M.I., NAKRST, M., GREGORC, A. (2012) **Effect of feeding with sugar syrups on honeybee (Apis mellifera carnica) longevity**. V: ČEH, Tatjana (ur.). 21. mednarodno znanstveno posvetovanje o prehrani domačih živali, Zadravčevi-Erjavčevi dnevi 2012. *Zbornik predavanj: Zadravec-Erjavec Days 2012, Radenci, November 8th and 9th, 2012*. Murska Sobota, p 99-104.

Vitellogenin

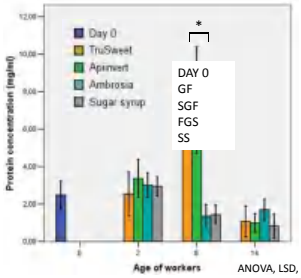


Vitellogenin slightly present at newly-emerged and 2 day-old workers



SDS-PAGE electrophoresis gel, Commassie blue

I. RESULTS: *TOTAL PROTEIN CONTENT IN HEMOLYMPH*



ANOVA, LSD, P < 0,01

PROTEINS IN BEE HEMOLYMPH

6 days bees (lab test 120 bees):

. Beebread 27,57 µg protein / µl, 68,76 % vitellogenin
. Soya/yeast 24,06 µg protein / µl, 47,40 % vitellogenin
. Pollen 11,36 µg protein / µl, 26,85 % vitellogenin
. Corn 3,98 µg protein / µl, 10,96 % vitellogenin
. Sugar 2,17 µg protein / µl, 5,48 % vitellogenin

Cremonez, T.M., De Jong, D., Bitondi, M.M. 1998. Quantification of hemolymph proteins as a fast method for testing protein diets for honey bees. J. Econ. Entomol. 91: 1284-1289.

I. RESULTS: *SUGAR CONCENTRATION IN HEMOLYMPH*

AGE (days)	GLUCOSE (mg/ml), ±SD, n=3							
	GF		SGF		FGS		SS	
2	30,15	±0,35	**28,17**	±5,51	22,43	±7,04	29,97	±9,35
8	30,57	±18,98	**41,10**	±3,04	25,13	±12,68	30,05	±11,10
14	21,62	±16,85	**25,53**	±14,51	24,53	±2,13	46,62	±12,40

AGE (days)	FRUCTOSE (mg/ml) ± SD, n=3							
	GF		SGF		FGS		SS	
2	2.00	±0.42	10.07	±4.35	9.47	±10.21	2.70	±0.82
8	4.30	±2.33	9.83	±4.88	3.95	±1.63	7.60	±2.83
14	2.70	±0.00	10.72	±0.84	6.33	±1.33	8.83	±6.42

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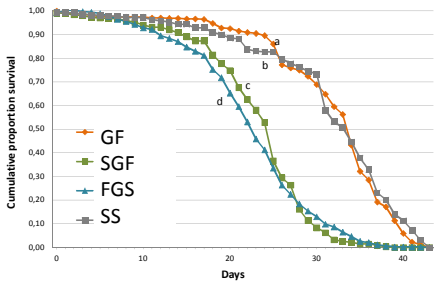
II. RESULTS: SUMMER BEES - *Survival*



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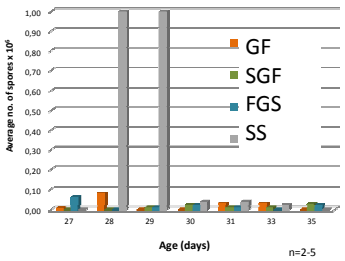
II. RESULTS: *Nosema spores*



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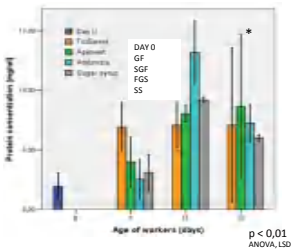
II. RESULTS: *TOTAL PROTEIN CONTENT IN HEMOLYMPH*



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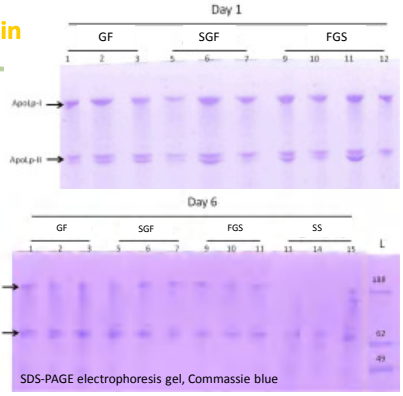
Vitellogenin

NO VITELLOGENIN IN HEMOLYMPH



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II. RESULTS: *SUGAR CONCENTRATION IN HEMOLYMPH*

AGE (days)	GLUCOSE (mg/ml) ± SD, n=3							
	GF		SGF		FGS		SS	
1	9,37	±2,11	7,8	±3,48	10,97	±5,5	3,3	±0,57
7	43,77	±5,13	34,47	±4,75	34,27	±14,65	46,26	±38,97
16	3,65	±1,62	13,0	±1,34	5,73	±4,46	15,87	±2,38

AGE (days)	FRUCTOSE (mg/ml) ± SD, n=3							
	GF		SGF		FGS		SS	
1	1,0	/	1,5	±0,28	5,66	±4,91	2,3	/
7	3,93	±3,29	8,5	±1,05	5,3	±2,12	1,5	/
16	/	/	3,85	/	4,7	±4,59	12,19	±5,82

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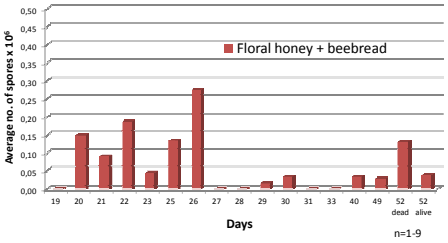
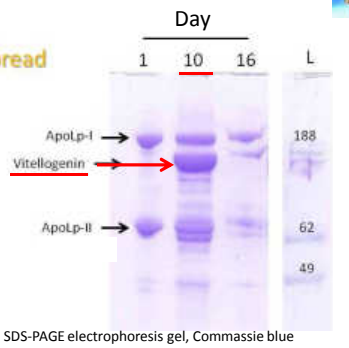
II. RESULTS: *Nosema spores*

SUMMER BEES: floral honey + beebread



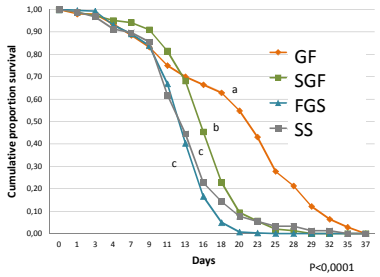
SUMMER BEES

Floral honey+bee bread

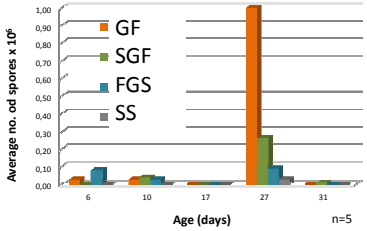


SDS-PAGE electrophoresis gel, Commassie blue

III. RESULTS: WINTER BEES - *Survival*



III. RESULTS: *Nosema spores*



III. RESULTS: *Ventriculus and apoptosis*

9 days old worker ——— **15 days** old worker

Peritrophical membrane

9 days old worker
Negative nuclei

——— **15 days** old worker
Positive nuclei
(brown reaction product)

Apoptosis in cell nuclei

CONCLUSIONS

- Bees from all three seasons survived best on GF syrup and SS (except winter bees).
- Nosema mostly infected older bees (>25 days) fed SS or GF (winter bees).
- Vitellogenin was not detected in caged bees fed sugar syrup. The highest protein titre was found in GF/SGF groups in younger spring bees and in FGS group in younger summer bees.
- Glucose content was high in younger spring bees (SGF) and in all 4 groups in summer bees. Fructose was sig. different between the groups in spring bees.
- Cell nuclei in ventriculus of winter bees were apoptotic in older bees (15 days).
- Our results indicate that sugar syrups have several impacts on honeybees.

ACKNOWLEDGEMENTS

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European Union

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