

# IMPACT OF DIFFERENT FEED ON INTESTINE HEALTH OF HONEY BEES

Msc Goran Mirjanic, University of Banja luka, Faculty of  
Agriculture, Bosnia and Herzegovina

Doc. dr Ivana Tlak Gajger, University of Zagreb, Faculty of  
Veterinary Medicine, Croatia

Prof. dr Mica Mladenovic, University of Belgrade, Faculty of  
Agriculture, Serbia

Prof. dr Zvonimir Kozaric, University of Zagreb, Faculty of  
Veterinary Medicine, Croatia

# INTRODUCTION

- Honeybee meets their needs from the four natural sources: nectar, honey, pollen and water,
- Sometimes there is need of supplemental feeding of bees, which is prepared in two ways: using acid and enzymatic hydrolysis of sugar,
- Both of these chemical processes are in the service of a smaller physiological exhaustion of honeybees, given that it uses only simple sugars for its own needs,
- Residual acid in bee food causes splitting of its intestinal tract, with significantly shortening of bee's life,
- Enzymatic hydrolysis of sugar, with the help of enzymes sucrase-invertase, is a slower process, but without the harmful effects on the life of bees.

# MATERIAL AND METHODOLOGY

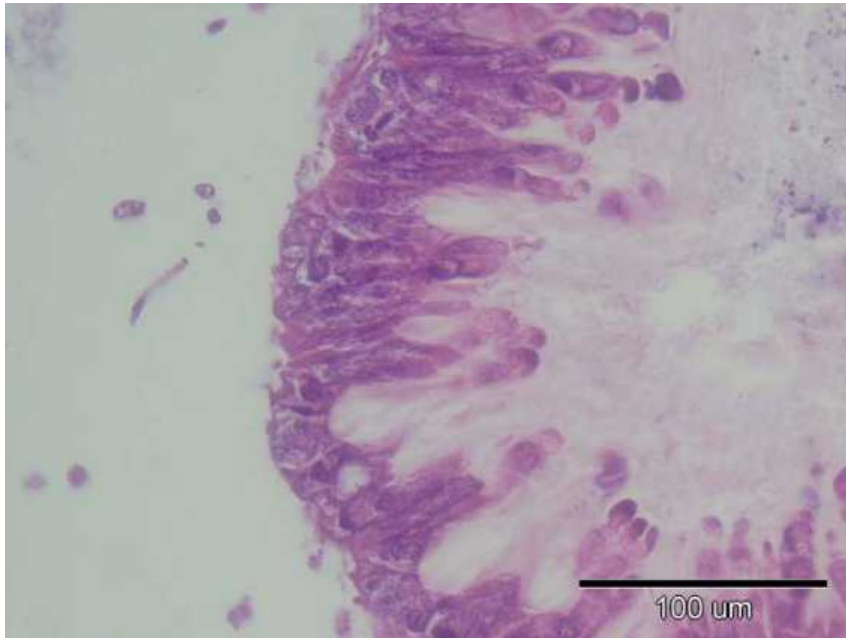
- Study was carried out on the experimental apiary, in controlled conditions. The experiments were performed on indigenous race of bees (*Apis mellifera carnica*) from the north-western part of Bosnia and Herzegovina.
- Experimental cages were filled with 200 bees, which were fed through two netted holes with prepared foods, according to experimental design.
- In the experiment, we used the following sources of bee food:
  - Acacia honey (control group),
  - Sugar syrup,
  - Acidic invert syrup (used tartaric acid)
  - Enzymatic invert syrup.
- Experimental groups of bees were fed in following variants:
  - Diet only with syrup (sugar, acid and enzymatic)
  - Diet with syrup plus 40 g brewer's yeast,
  - Diet syrups with 40 gr beer wort,
  - Diet syrups with 20 gr brewer's yeast and 20 g beer wort,

# THE OBJECTIVES OF THE WORK WERE TO DETERMINE

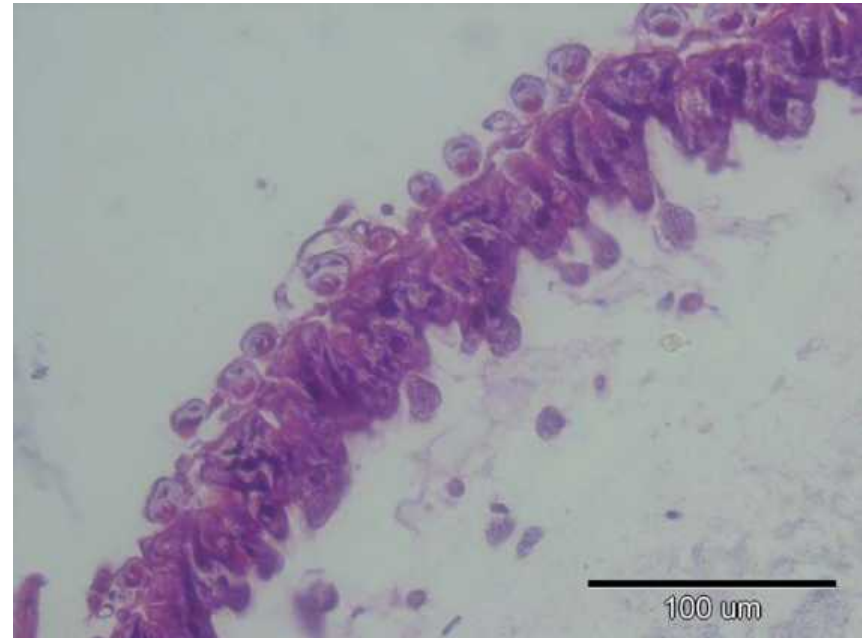
1. the optimal feed source for bees as a honey substitution,
2. the effect of different feed to midgut epithelial layer of bees,
3. the effect of different types of feed to the length of their lives.

# RESULTS

Picture 1. Middle gut of bee fed with accacia honey



Picture 2. Middle gut of bee fed with sugar syrup



# RESULTS

## Middle gut of bee fed with accacia honey

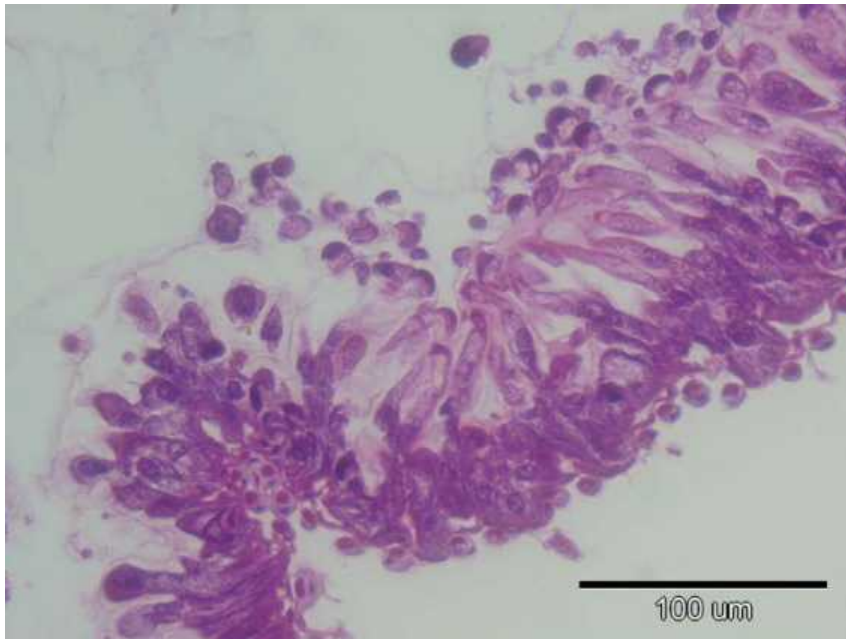
- Epithelial cells of the midgut are quite conservative, high and are closely adherent to each other;
- Intestinal contents are quite homogeneous and compact, and fit close to the intestinal epithelium, which suggested well digested food.

## Middle gut of bee fed with sugar syrup

- Midgut wall is properly wrinkled, and in close contact with intestinal content;
- Epithelial cells are properly arranged on the inside intestinal wall;
- Slightly damaged top layer of epithelial cells was found, which is not present in all cells;
- Intestinal contents are not homogeneous, fairly loose consistency and lie directly on the intestinal epithelium.

# RESULTS

Picture 3. Middle gut of bee fed  
with sugar syrup and yeast



Picture 4. Middle gut of bee fed  
with sugar syrup and beer wort



# RESULTS

Middle gut of bee fed  
with sugar syrup and yeast

- Occurrence of spacing between individual epithelial cells and their not homogeneous distribution;
- As with sugar syrup diet, intestinal content is not homogeneous, fairly loose consistency and directly next to intestinal epithelium.

Middle gut of bee fed  
with sugar syrup and beer wort

- Quite stretched bowel wall, leading to its reduced absorptive ability;
- Epithelial cells have damaged surface, while one part of the high epithelial cells missing, with only regenerative cells visible;
- Intestinal content is not homogeneous, fairly loose consistency and lies directly on the intestinal epithelium.

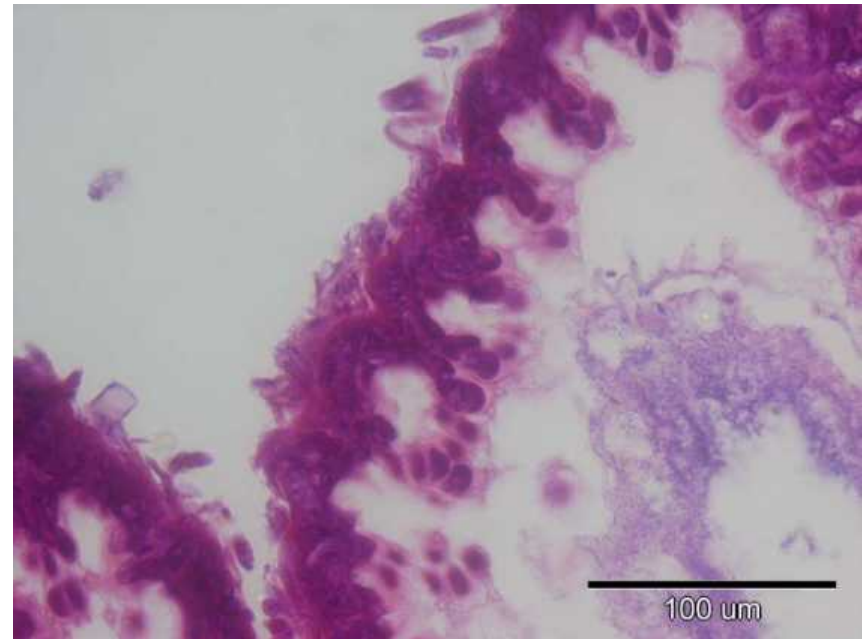


# RESULTS

Picture 5. Middle gut of bee fed with sugar syrup, yeast and beer wort



Picture 6. Middle gut of bee fed with acid invert syrup



# RESULTS

Middle gut of bee fed  
with sugar syrup, yeast and beer wort

- Bowel wall quite stretched and thinned, so transverse wrinkles are not visible;
- Pronounced peak damage of epithelial cells, with their lack in intestinal epithelium (due to damage);
- Intestinal contents partially lies on the epithelium, with a good portion of the content compressed in the center of the intestine.

Middle gut of bee fed  
with acid invert syrup

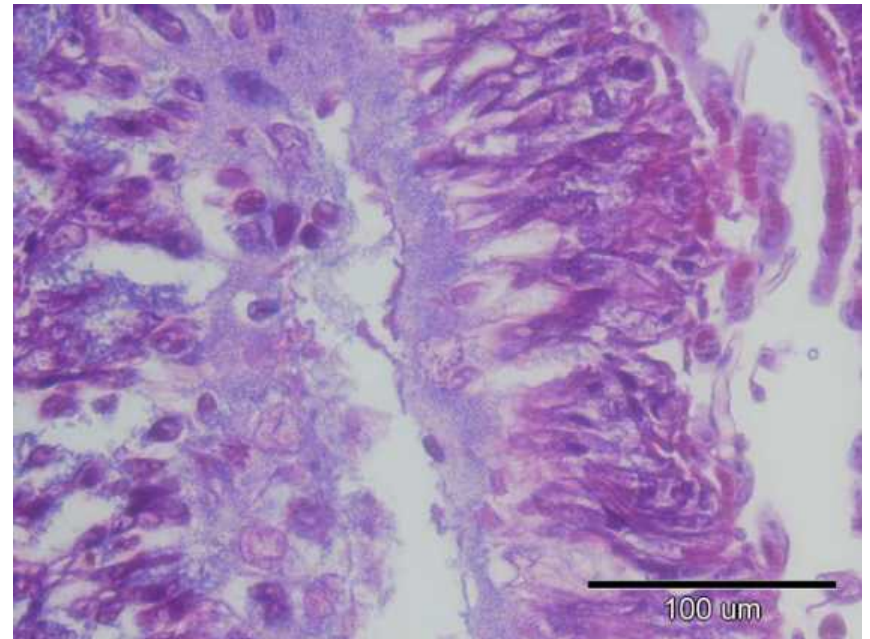
- Epithelial cells are widely separated, there are a number of gaps between them, which are manifested in the form of deep indentations in the epithelium;
- Almost totally damaged high columnar epithelial cells, with only regenerative cells not changed;
- Content in the intestinal lumen is rather loose consistency, with visible parts of disbanded cells.

# RESULTS

Picture 7. Middle gut of bee fed  
with acid invert syrup and yeast



Picture 6. Middle gut of bee fed  
with acid invert syrup and beer wort



# RESULTS

Middle gut of bee fed  
with acid invert syrup and yeast

- A similar situation as with acid syrup, but with epithelial cells better preserved;
- there are sites of observed damage, which cover almost the entire depth of the epithelium.

Middle gut of bee fed  
with acid invert syrup and beer wort

- A complete layer of epithelial cells rather damaged by depth, but fairly compact and in close contact with intestinal content;
- Intestinal content of rather homogeneous consistence.

# RESULTS

Picture 9. Middle gut of bee fed with acid invert syrup, yeast and beer wort



Picture 10. Middle gut of bee fed with enzyme invert syrup



# RESULTS

Middle gut of bee fed with acid invert syrup, yeast and beer wort

- About  $2/3$  of the total thickness of the epithelial layer is damaged on the entire surface of the lumen;
- Damaged epithelium is quite compact and homogeneous composition.

Middle gut of bee fed with enzyme invert syrup

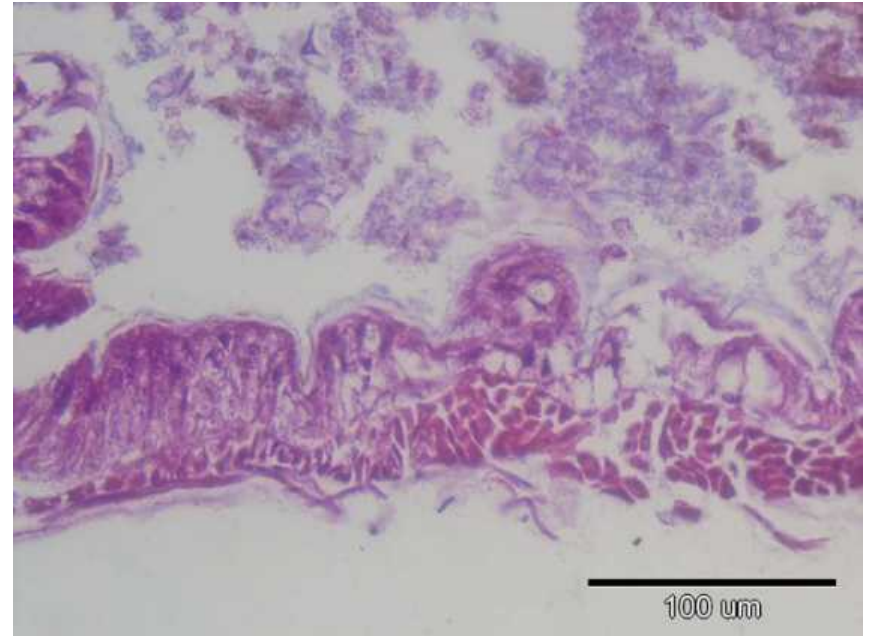
- High columnar epithelial cells properly aligned on the basal membrane of the transverse corrugated pipes midgut;
- Partially separated peritrophic membrane which wraps some slightly loose bowel contents.

# RESULTS

Picture 11. Middle gut of bee fed with enzyme invert syrup and yeast



Picture 12. Middle gut of bee fed with enzyme invert syrup and beer wort



# RESULTS

Middle gut of bee fed with enzyme invert syrup and yeast

- Slightly damaged surface epithelial cells and thereby expressed regenerative cells;
- Content in the lumen of the intestine is friable structure and directly adjacent to the midgut epithelium.

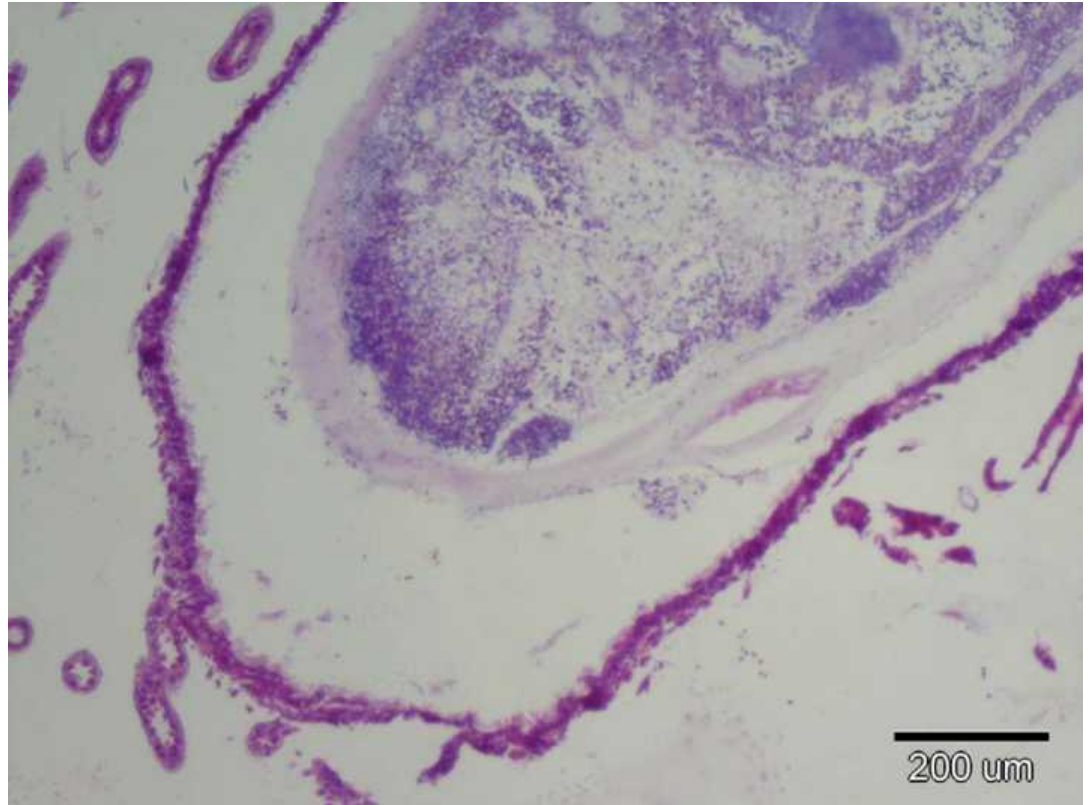
Middle gut of bee fed with enzyme invert syrup and beer wort

- in some places, the epithelial layer is totally damaged to the muscle layer;
- residual content in the intestinal lumen, organized in homogeneous clusters.



Picture 13. Middle gut of bee fed with enzyme invert syrup, yeast and beer wort:

- Epithelial cells are deeply damaged throughout all gut surface;
- Intestinal contents is compressed into a homogenous mass within the gut lumen, with a belted one homogeneous layer, it is difficult to digest for the bees.



# The effect of feed source on the longevity of winter bees

Feed type	Life span of bees (days)			
	Year			
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	<i>x</i>
Honey	26,55	29,46	25,15	<b>27,05</b>
Sugar Syrup	20,52	26,32	18,90	<b>21,91</b>
Sugar S. + Yeast	21,64	20,77	19,12	<b>20,51</b>
Sugar S. + Beer Wort	16,85	18,53	15,18	<b>16,85</b>
S. S. +Yeast + Beer wort	17,46	18,82	18,82	<b>18,37</b>
Acid inv. syrup	10,30	15,17	10,98	<b>12,15</b>
Acid inv. s. + Yeast	15,50	17,70	17,06	<b>16,75</b>
Acid inv. s. + Beer Wort	16,59	18,76	16,82	<b>17,39</b>
Acid inv. s. +Yeast+Beer Wort	16,44	18,92	18,26	<b>17,87</b>
Enzyme syrup	24,98	26,82	19,43	<b>23,74</b>
Enzyme syrup+Yeast	20,32	16,74	19,87	<b>18,98</b>
Enzyme syrup+Beer Wort	15,38	20,00	15,91	<b>17,10</b>
Enzyme s.+Yeast+Berr Wort	20,06	18,69	18,89	<b>19,21</b>

# CONCLUSION

- Based on our research, it can be concluded that feeding with different food sources has different influence on the digestive tract of bees, especially in the midgut epithelial layer.
- Natural source of food for bees - honey had no harmful effects on the midgut epithelial layer, and the intestinal contents were completely attached to this layer, which leads to the quality of digestion and maximum nutrient resorption. Similar results were got when feeding bees with sugar syrup and enzyme inverted syrup without the addition of yeast and malt.
- This means that each addition of yeast and malt lead to damage to the midgut epithelial layer, and the differences arise, depending on food source. The most serious damage on the epithelial layer was found in midgut of bees fed with acidic invert syrup (in all examined combinations).
- Regarding the impact of different feed on the length of life of bees, it can be concluded that feeding with honey, enzyme invert sugar syrup had a positive effect on the life span of bees, while addition of brewer's yeast and wort shortens the life of bees, so recommendation is to use supplemental feeding without them, and that the use of these supplements should be more practiced during other seasons, especially if there is no natural pollen.