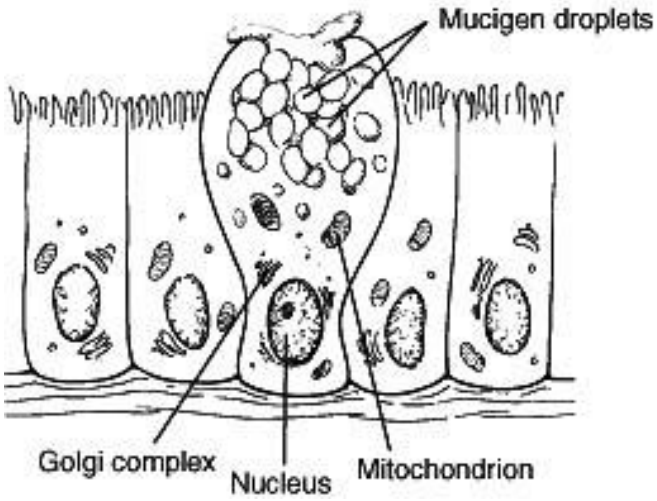
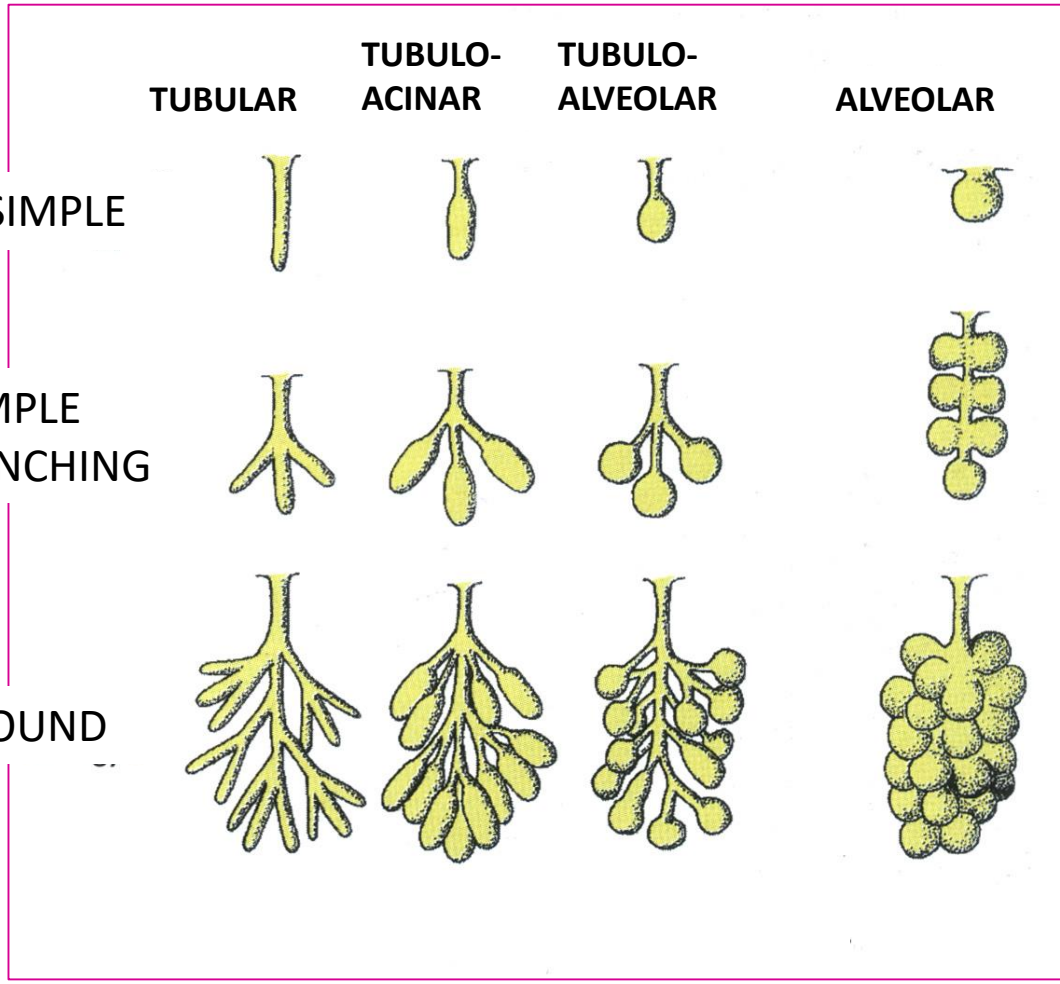
Goblet cells and Mast cells during parasitic infection

MORPHOLOGICAL TYPES

UNICELLULAR
Individual secretory cells
(goblet cells)



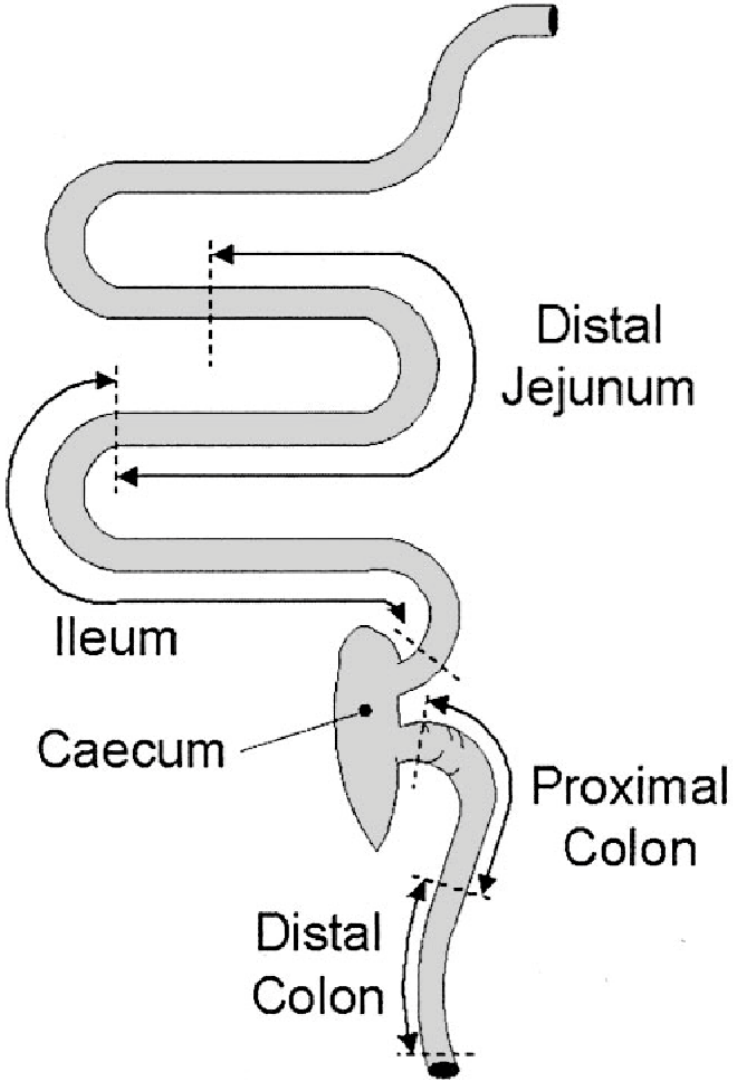
MULTICELLULAR
Organs containing glandular epithelium
(large glands, crypts)



The talent of goblet cells is to secrete mucus, a viscous fluid composed primarily of highly glycosylated proteins called mucins suspended in a solution of electrolytes. Mucus serves many functions, including protection against shear stress and chemical damage, and, especially in the respiratory tree, trapping and elimination of particulate matter and microorganisms.

Distribution and Morphology

Goblet cells are found scattered among other cells in the epithelium of many organs, especially in the intestinal and respiratory tracts. In some areas, their numbers are rather small relative to other cell types, while in tissues such as the colon, they are much more abundant.



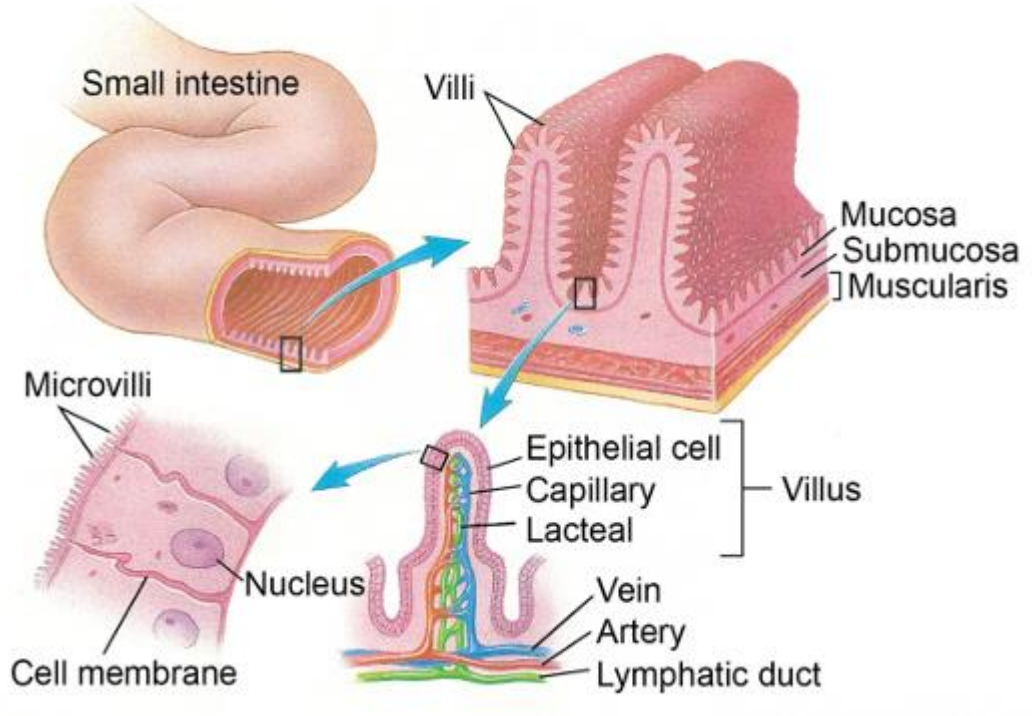
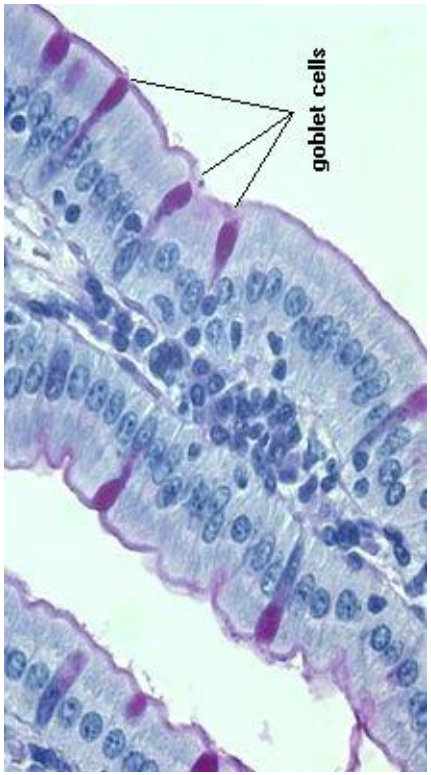
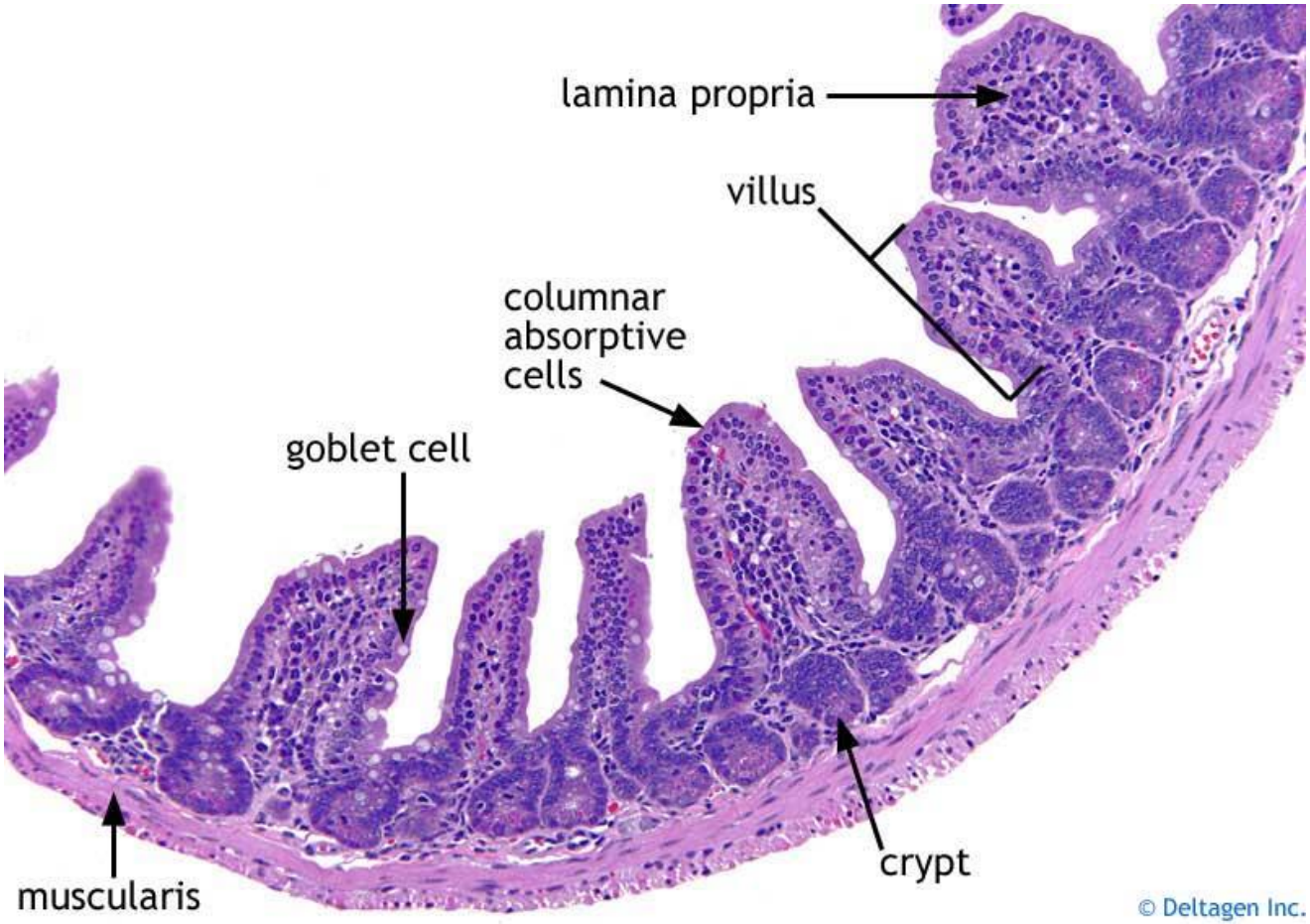


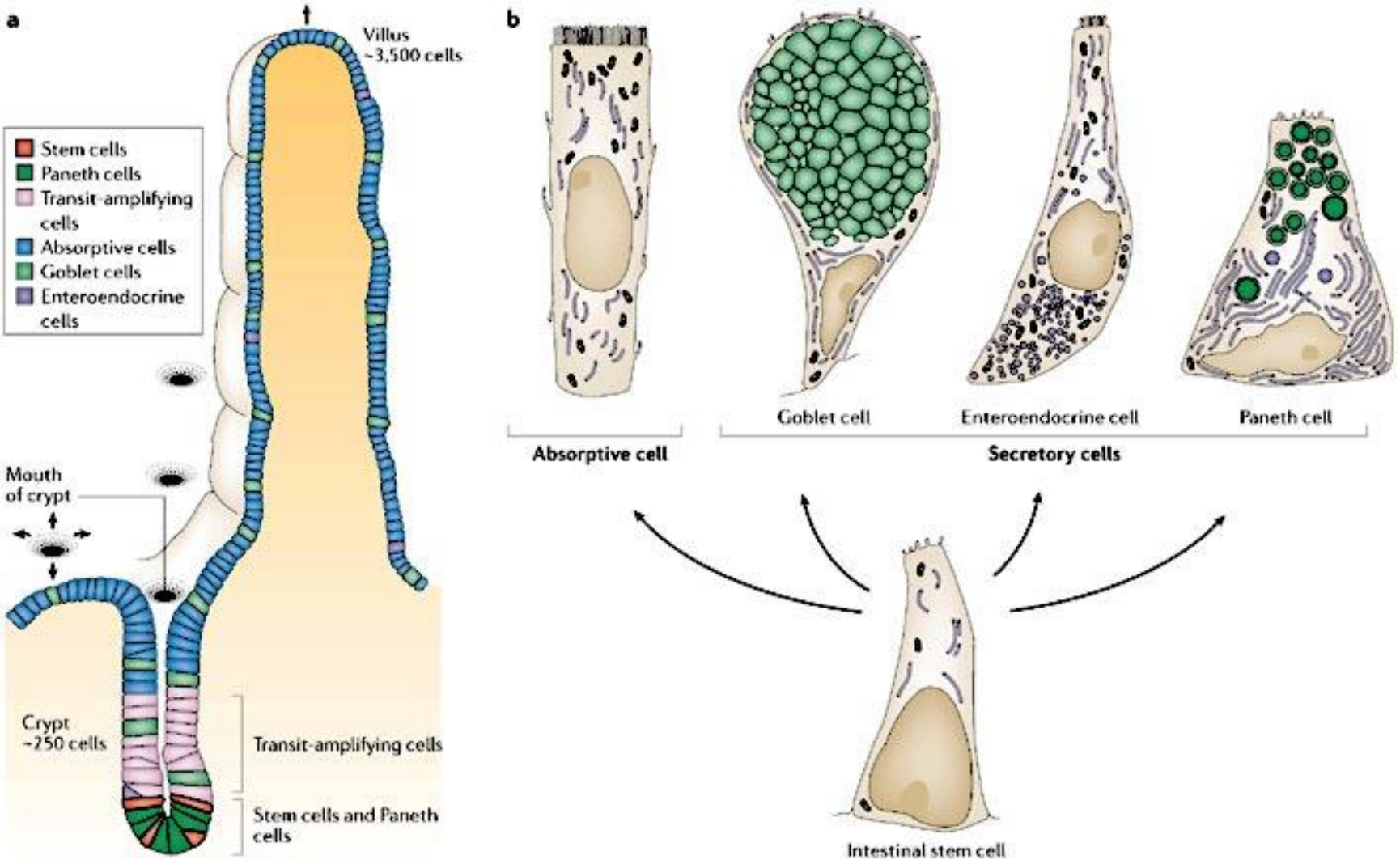
Fig. 1. Intestinal regions used in this study. A diagram of the isolated

The image below is of a villus in the small intestine of a mouse. The section was stained using the periodic acid-Schiff technique, which stains glycoproteins, including mucins, bright purple.

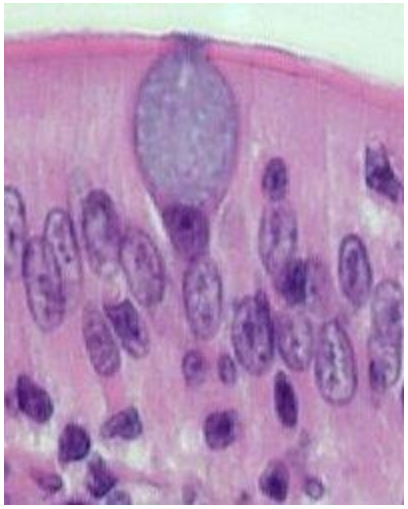




Stem cell



The large majority of cells covering the villus are absorptive epithelial cells, but several goblet cells are clearly visible. A similar type of situation is observed in bronchial and tracheal epithelium.



The name goblet cell derives from the characteristic shape of these cells in conventionally-fixed tissues: a narrow base and expanded apical portion that sometimes extends into the lumen. This morphology, as seen to the right in a section of cat small intestine (H&E stain), is known to be an artifact of fixation in which mucus-laden granules in the apical portion of the cell expand, causing the cell to balloon. If special precautions are taken during fixation, goblet cells are seen as cylindrical cells

Genes for Goblet cells

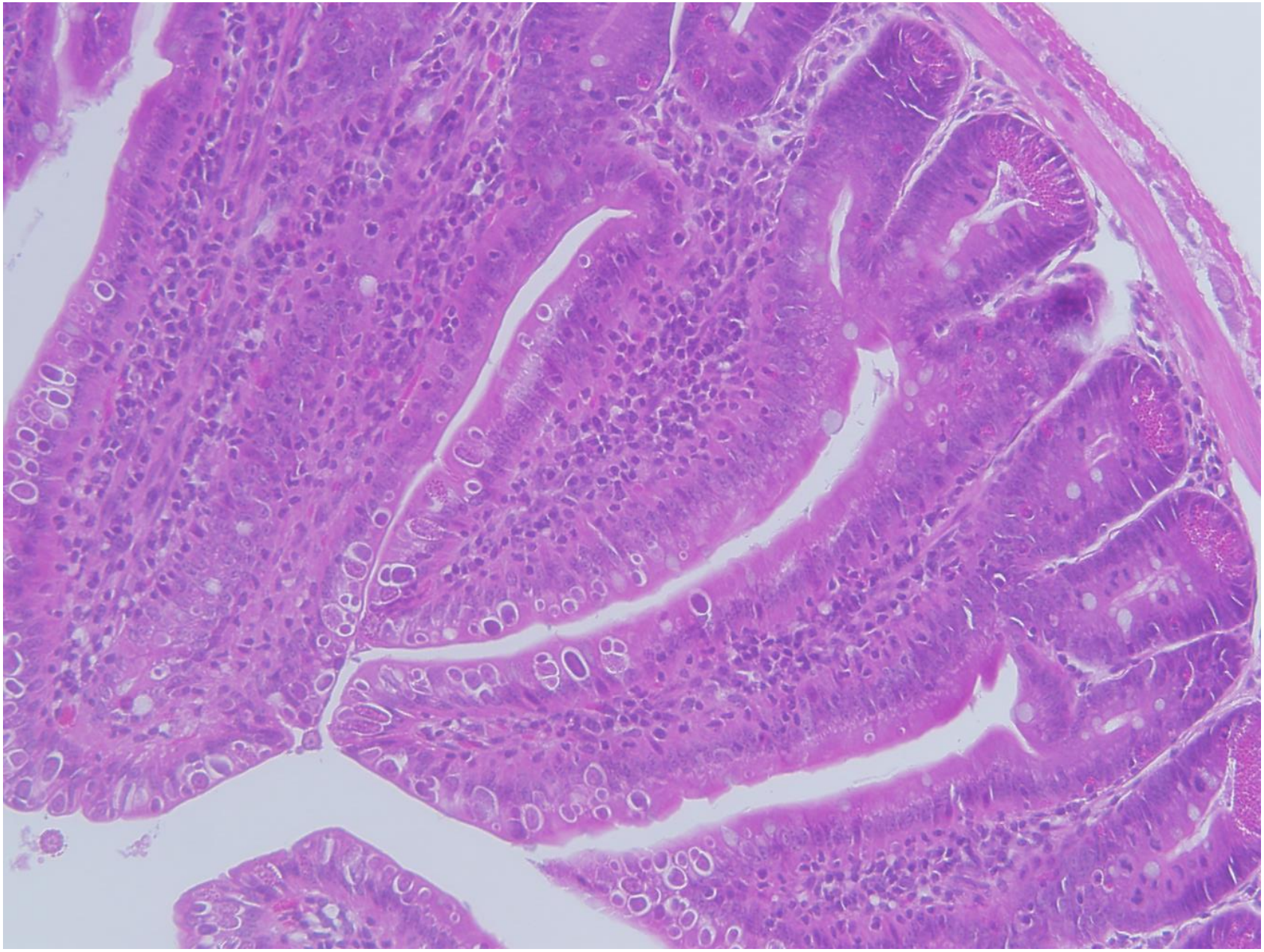
synthesize secretory mucin glycoproteins **(MUC2)** and bioactive molecules such as epithelial membrane-bound mucins (MUC1, MUC3, MUC17), trefoil factor peptides (TFF), resistin-like molecule β (RELMβ), and Fc-γ binding protein (Fcgbp).

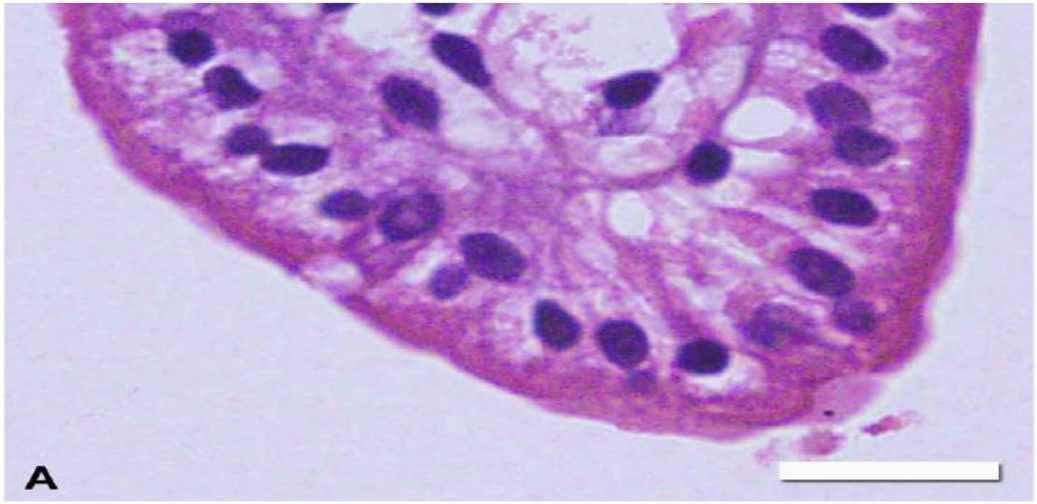
Parasite number and goblet cells

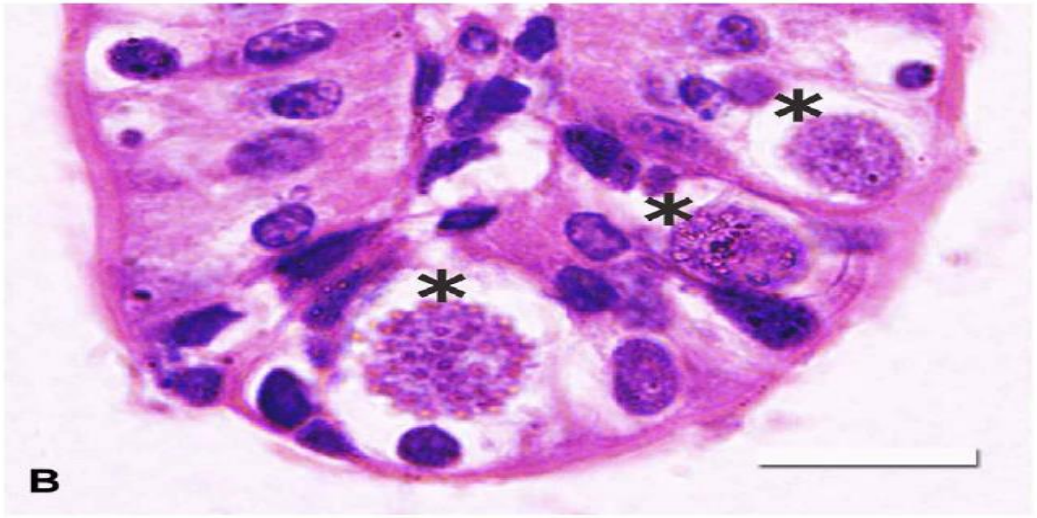
Sections stained with hematoxylin–eosin were used for parasite detection or with **Alcian blue** for determination of the goblet cells. For each animal, the number of goblet cells in the jejunum was counted on at least ten well-orientated villous-crypt units (VCU). Results were expressed as the mean number of goblet cells per ten VCU (Allen et al. 1986). The number of parasitic infections in ten VCU (mainly found within the crypt) was counted.

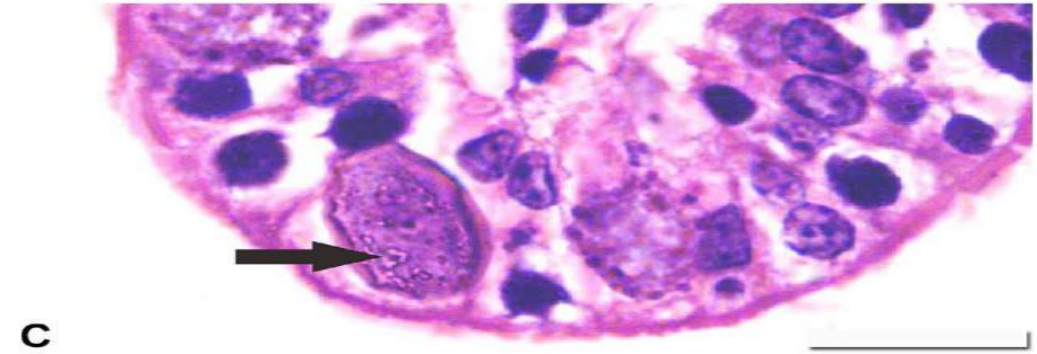
Infection with Eimeria

Intestinal Villi infected with *Eimeria papillata*

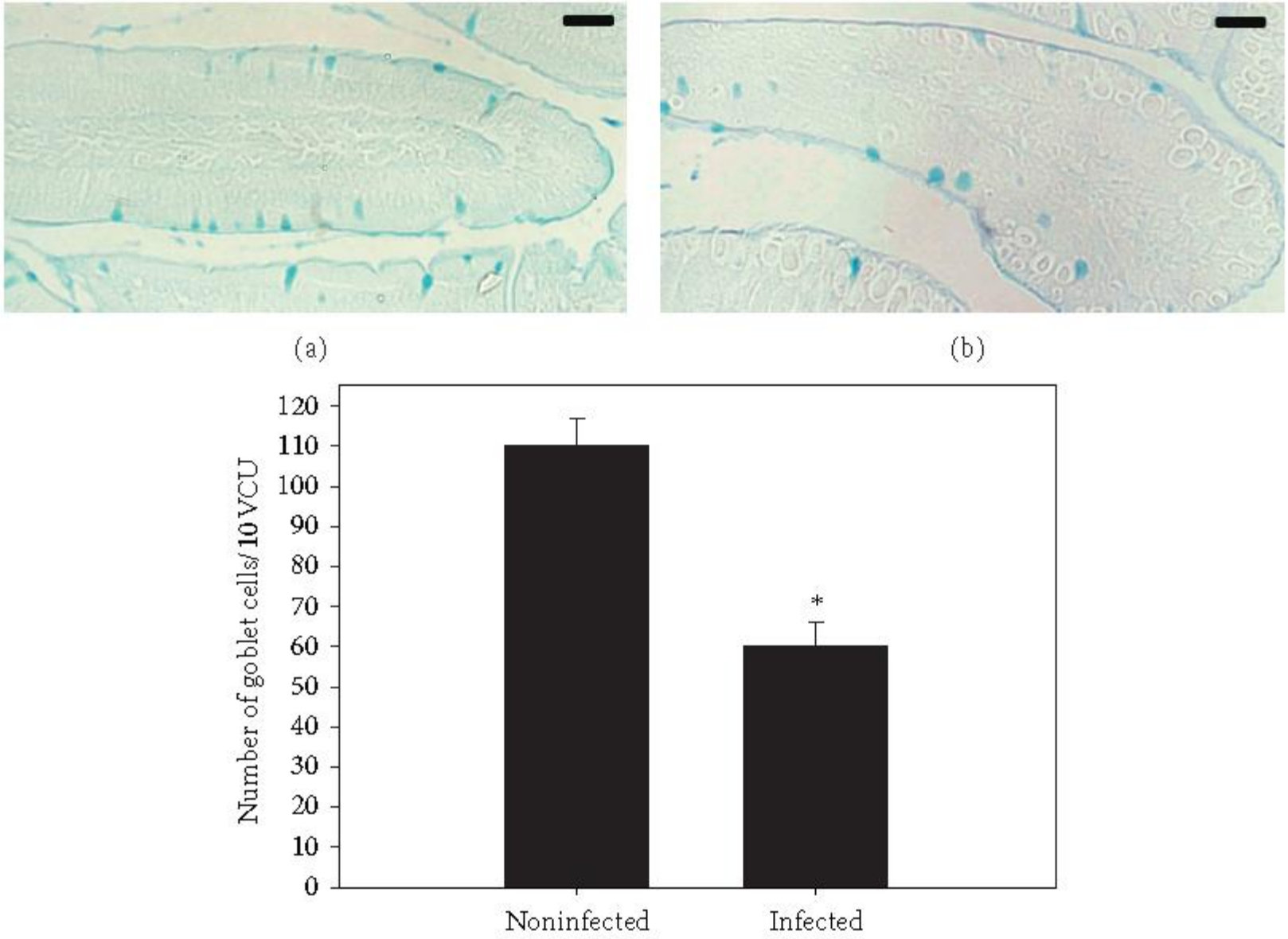


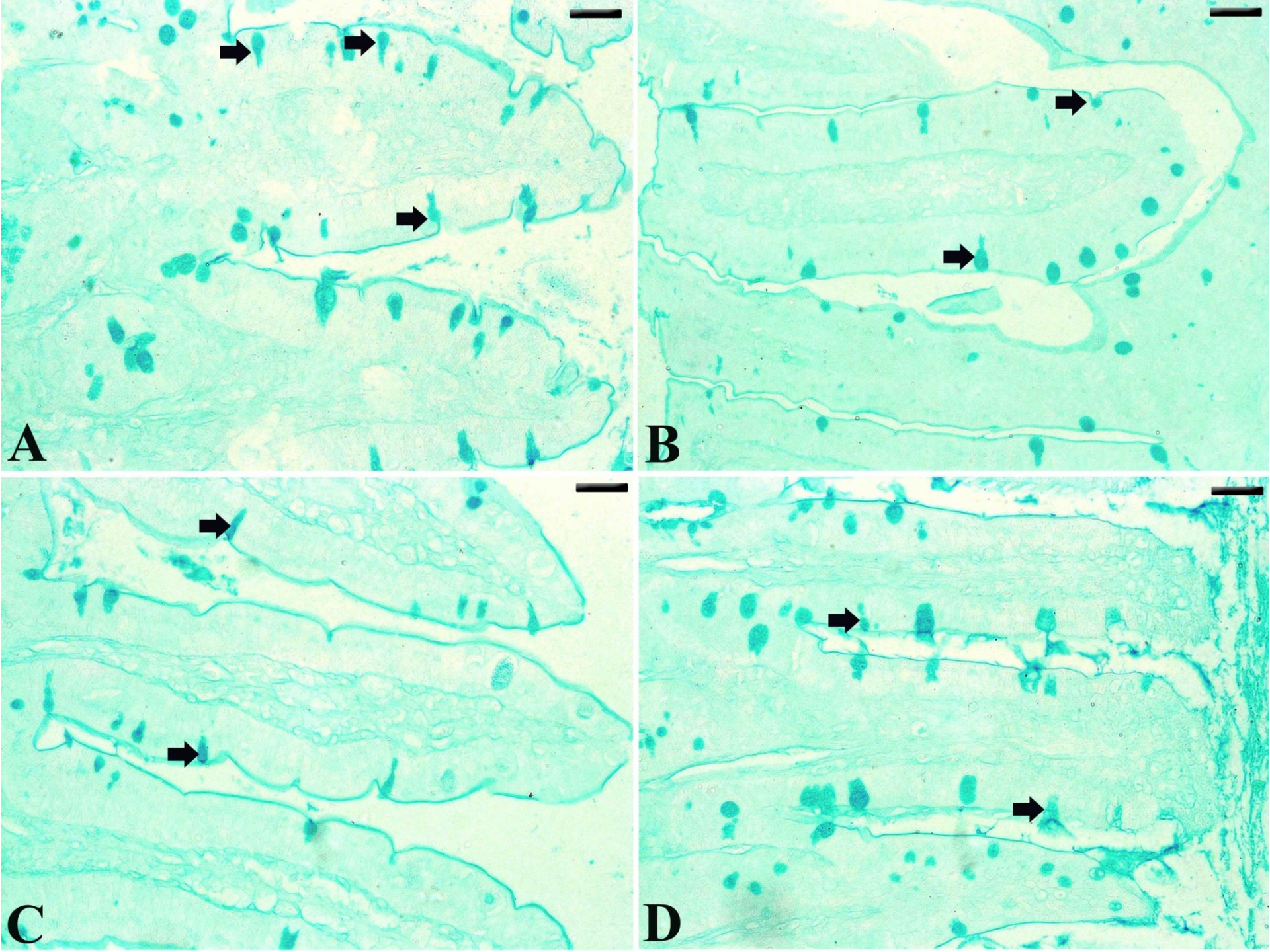

A

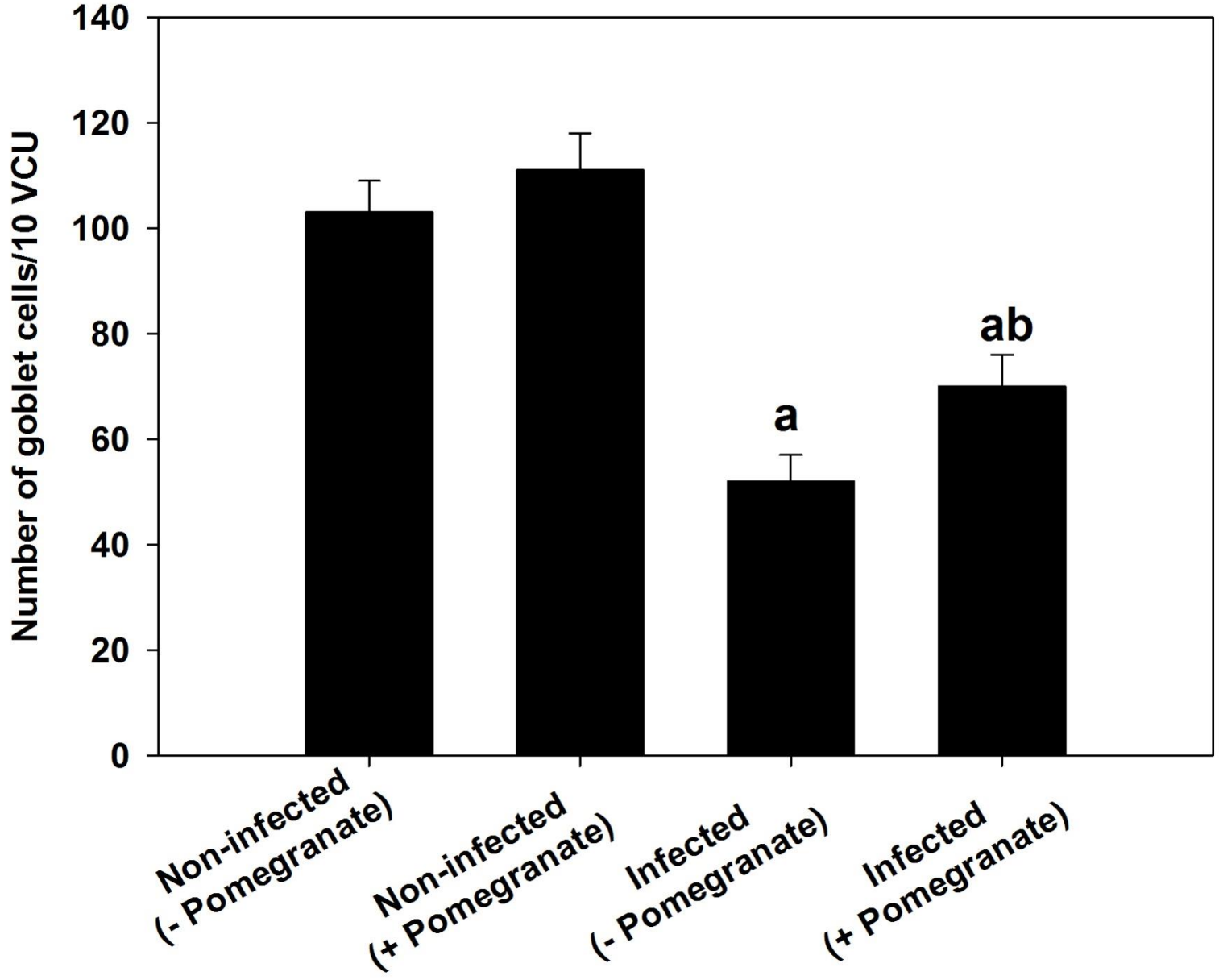

B


C

Alcian blue stain for determination of the goblet cells.




A
B
C
D


Number of goblet cells/10 VCU
140
120
100
80
60
40
20
0
a
ab
Non-infected
(- Pomegranate)
Non-infected
(+ Pomegranate)
Infected
(- Pomegranate)
Infected
(+ Pomegranate)

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Research Article

Goblet Cells and Mucin Related Gene Expression in Mice Infected with *Eimeria papillata*

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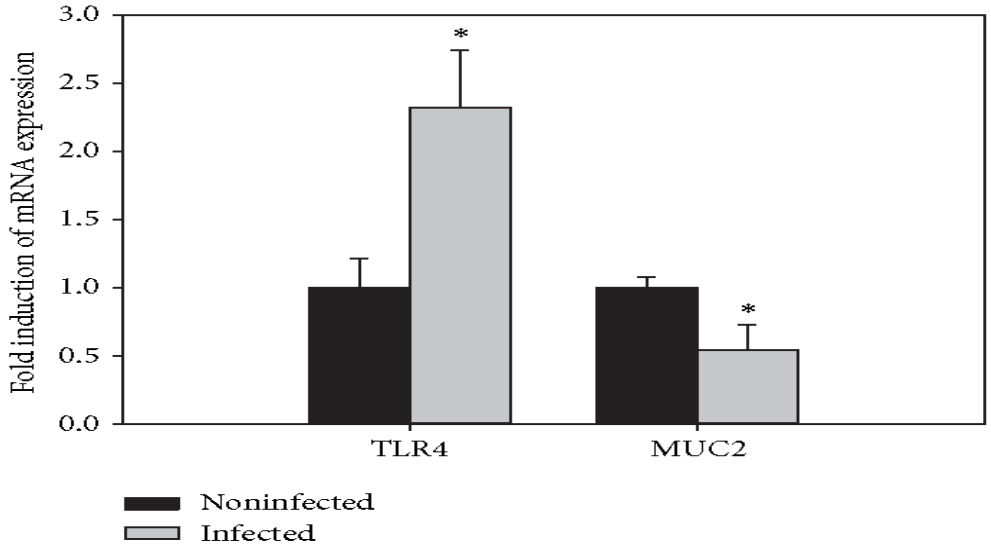


FIGURE 5: Quantitative RT-PCR analysis of TLR4 and MUC2 in the jejunum. Expression was analyzed in non-infected and infected mice on day 5 p.i., normalized to 18S rRNA signals, and relative expression is given as fold increase compared to the non-infected control mice. Values are means ± SD. * Significant change at $P < 0.01$ with respect to noninfected mice.

Table 1. Alteration in goblet cells and mucins responses during common enteric infections.

Enteric Infection		Goblet Cell & Mucin Response	Reference
Parasitic Infection	Helminth Infection		
	N. brasiliensis	Goblet cell hyperplasia; ⇧ Muc2, ⇧ sulfated mucins	[39,40,44,45]
	T. spiralis	Goblet cell hyperplasia; ⇧ Muc2/3	[43]
	T.muris	Goblet cell hyperplasia; ⇧ Muc2/4/13/17, ⇧ charged mucins	[37,38,95]
	Protozoal Infection		
	E. histolytica	⇩Mucins	[56]
Bacterial Infection	*C. Rodentium*	⇩ Mucins ⇧ Muc1	[96]
	H. pylori	⇩ Muc6/5ac, ⇧ Muc4	[61,97,98]
	C. jejuni	⇧ Muc1	[103]
Viral Infection	*Rota virus*	⇩ Goblet cell (early time points); ⇧ Muc2, ⇩ sulfated mucins	[79]

Plasmodium chabaudi

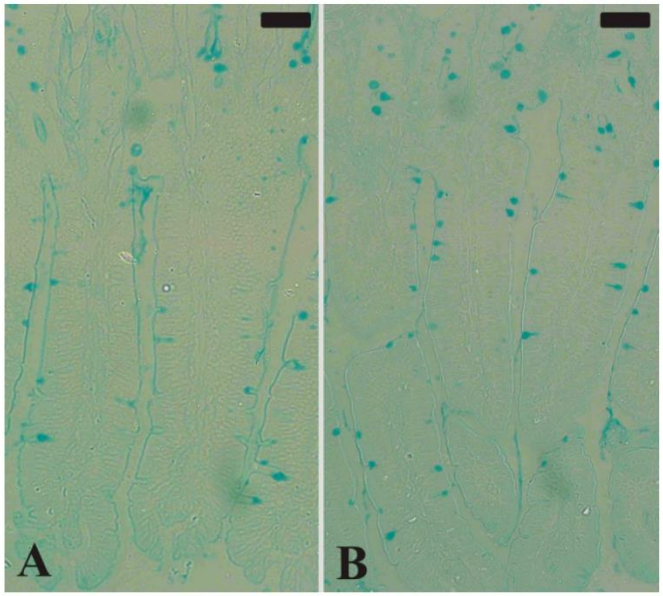


***Figure 3**. Goblet cells in mouse jejunum. Section from non-infected group **(A)** and P. chabaudi infected group **(B)**. Sections were stained with Alcian blue. Bar =50 µm.*

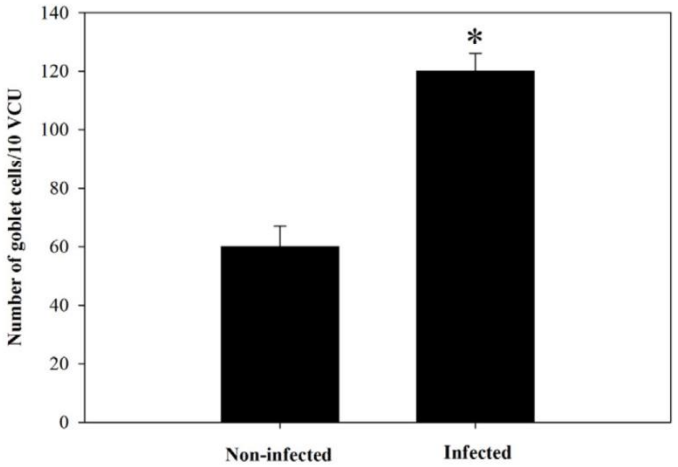


***Figure 4.** Goblet cell number in jejunum of non-infected and infected mice with P. chabaudi on day 8 p.i. Data were obtained from Alcian blue-stained sections as shown in Figure 3. Values are means ± SD. *Significance against non-infected group at $p \leq 0.05$.*

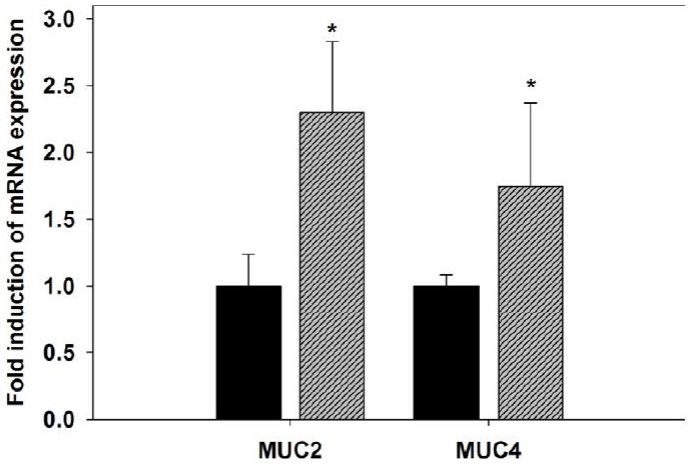
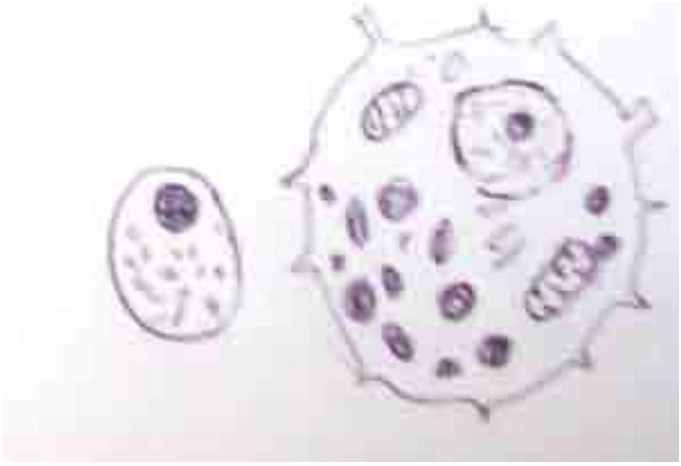


***Figure 5.** Quantitative RT-PCR analysis of MUC2 and MUC4 mRNA in the jejunum of mice. Expression was analyzed in non-infected and P. chabaudi infected mice on day 8 p.i., normalized to 18S rRNA signals, and relative expression is given as fold increase compared to the non-infected control mice. Values represent means ± SD. *Significance against non-infected male mice at $p \leq 0.05$.*

Mast cells



-They are small, oval or rounded or irregular shaped cells

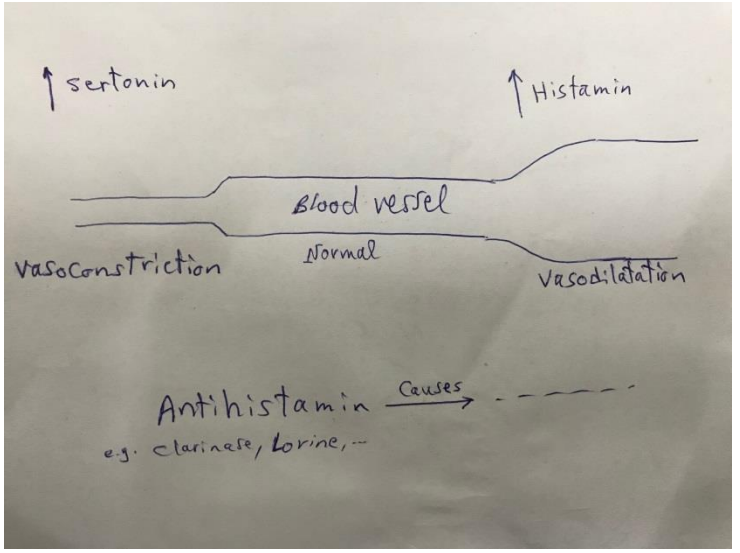
-They are present in groups around blood vessels

- They are rich in mitochondria and free ribosomes.

- The cytoplasm rich in secretory granules, each granule is enclosed by a membrane.

-The nucleus is present at one side (not central)

-Under E.M. the cell membrane appear irregular with cytoplasmic processes.



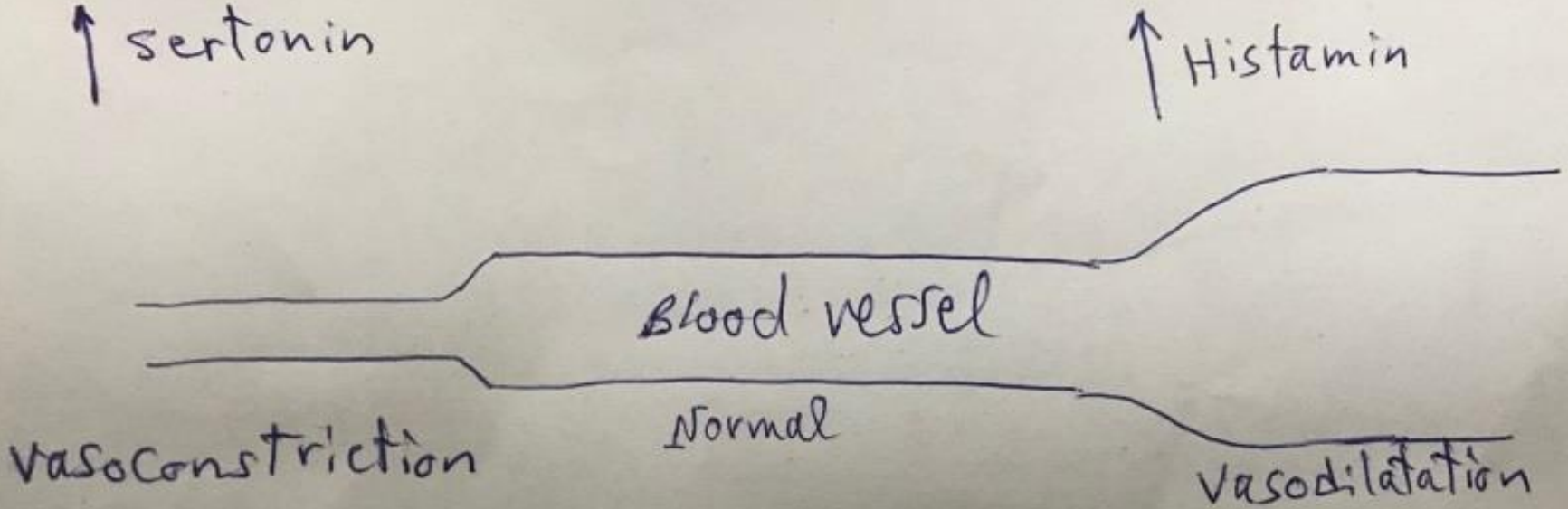
- Functions

- Formation of heparin which is an anti-coagulant

-Formation and storage of histamine which is related to allergy……..vasodilatation of B.Vs.

-Formation of sertonin……vasoconstriction of B.Vs.

-Clearance of blood from fat droplets



Antihistamin $\xrightarrow{\text{Causes}}$ - - - - - -

e.g. clarinase, Lorine, --

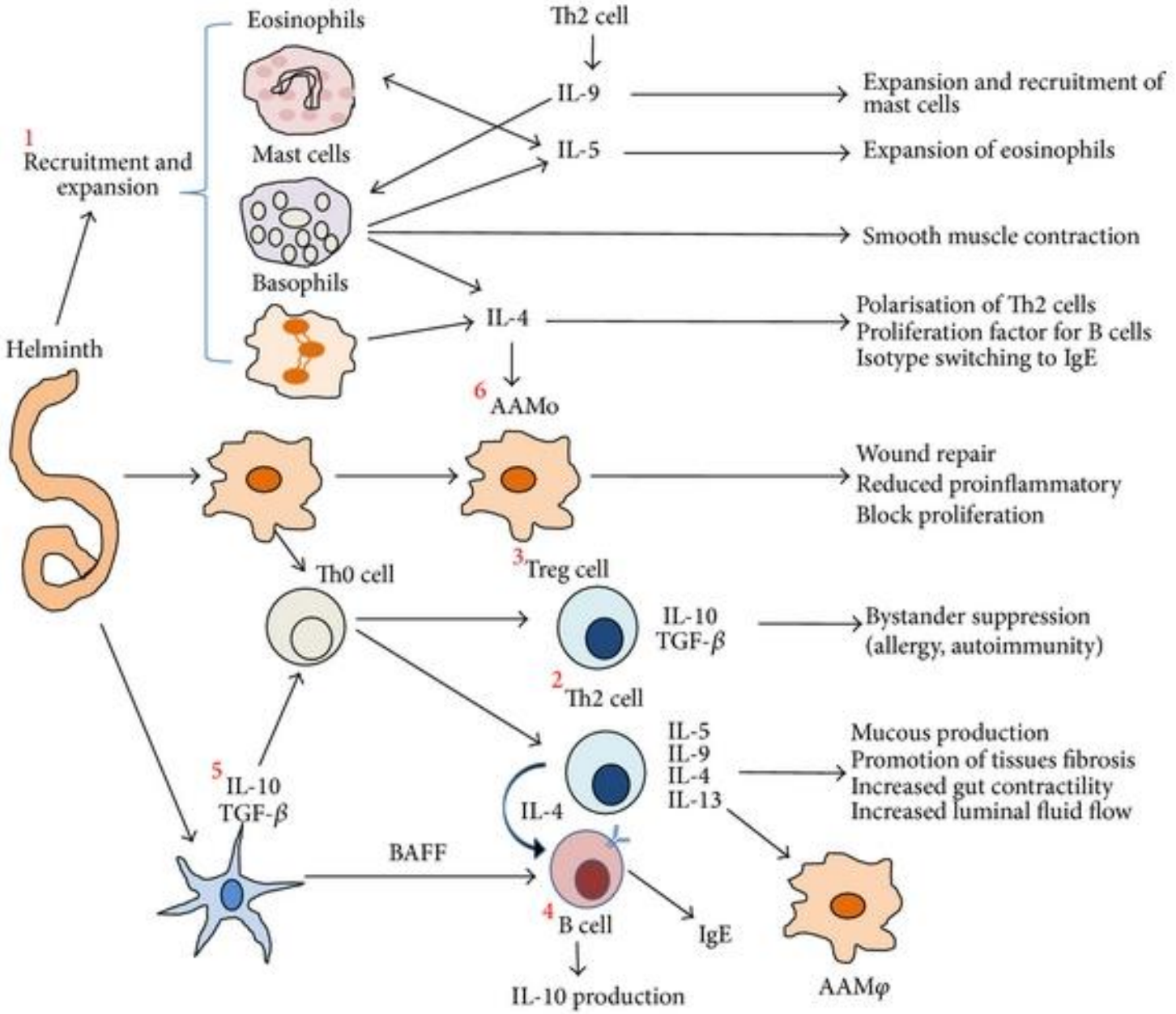
Mast cells during parasitic infection

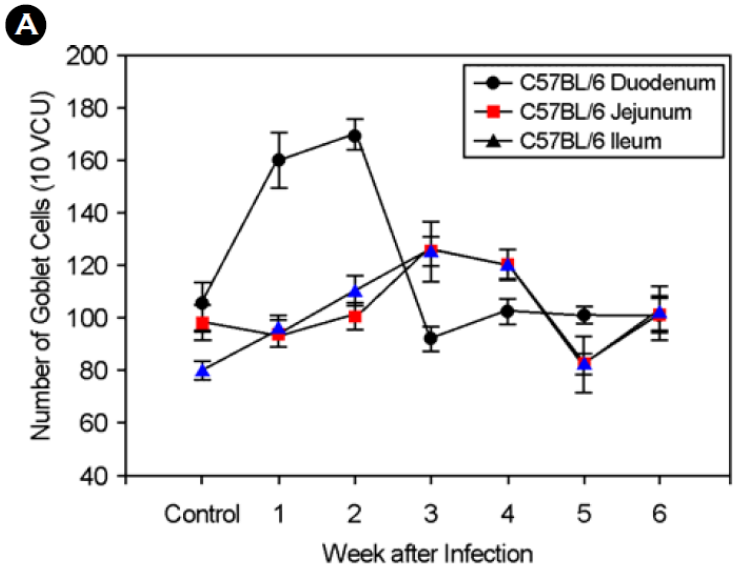
Mast cells in intestine mucosa play important roles in the immune response of the host, including the degranulation that is caused by parasites' antigenicity.

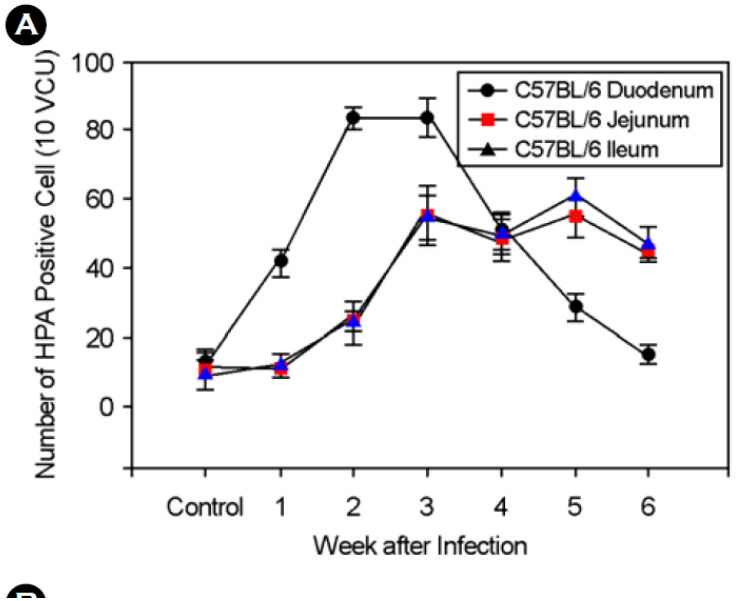
A nematoda infection increases the number of mast cells and the histamine secretion in the early period of infection.

At the later infection period, the number of mast cells recovers to a basal level, and this indicates what function the mast cells serve in early stage of parasite infection.

Mast cells are associated with allergic hypersensitivity and ion transport in the intestine.


Eosinophils
Th2 cell
IL-9
Expansion and recruitment of mast cells
1
Recruitment and expansion
Mast cells
IL-5
Expansion of eosinophils
Basophils
Smooth muscle contraction
IL-4
Polarisation of Th2 cells
Proliferation factor for B cells
Isotype switching to IgE
Helminth
6
AAMo
Wound repair
Reduced proinflammatory
Block proliferation
Th0 cell
3
Treg cell
IL-10
TGF-β
Bystander suppression
(allergy, autoimmunity)
2
Th2 cell
IL-5
IL-9
IL-4
IL-13
Mucous production
Promotion of tissues fibrosis
Increased gut contractility
Increased luminal fluid flow
5
IL-10
TGF-β
IL-4
BAFF
4
B cell
IgE
IL-10 production
AAMφ

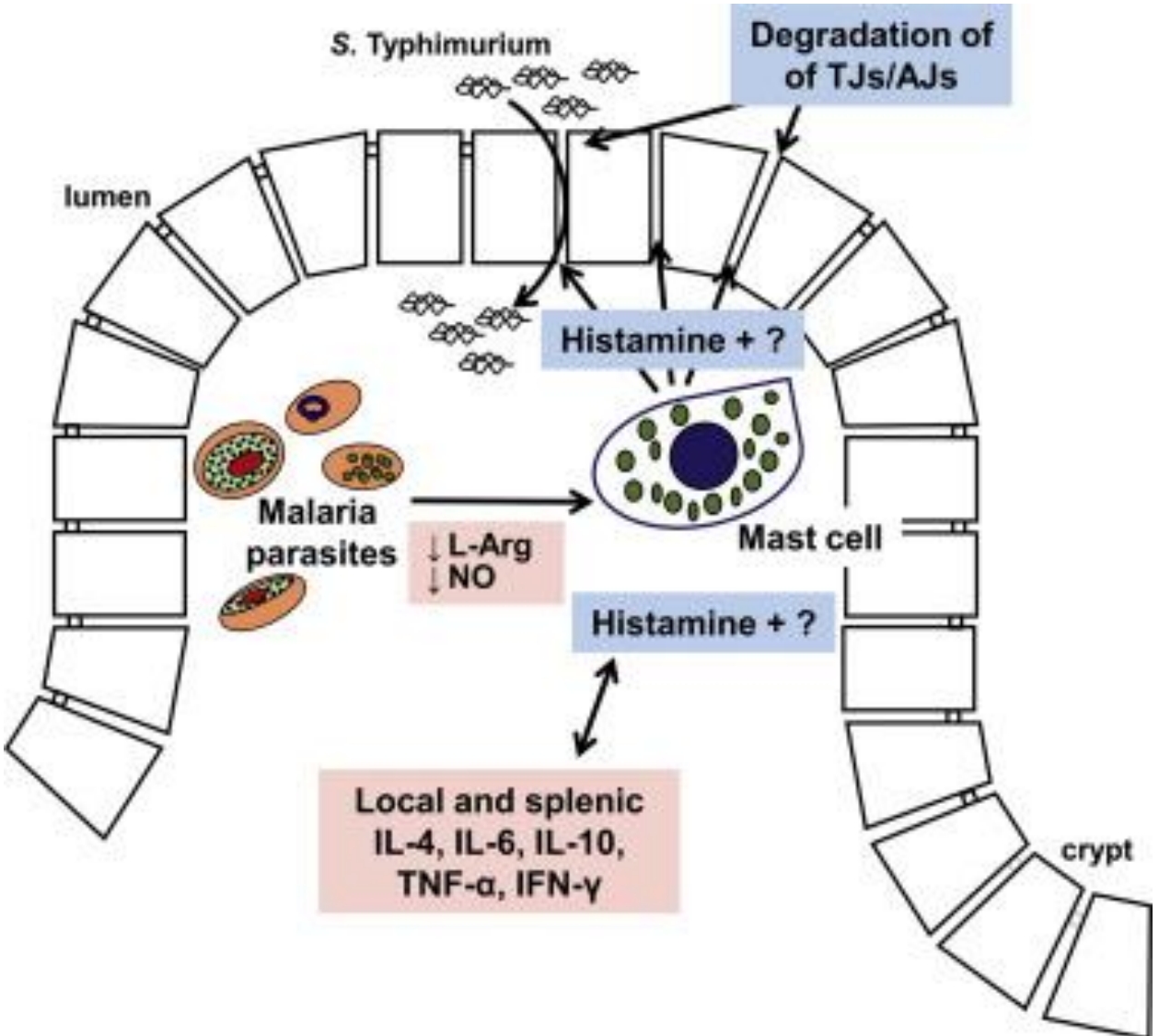


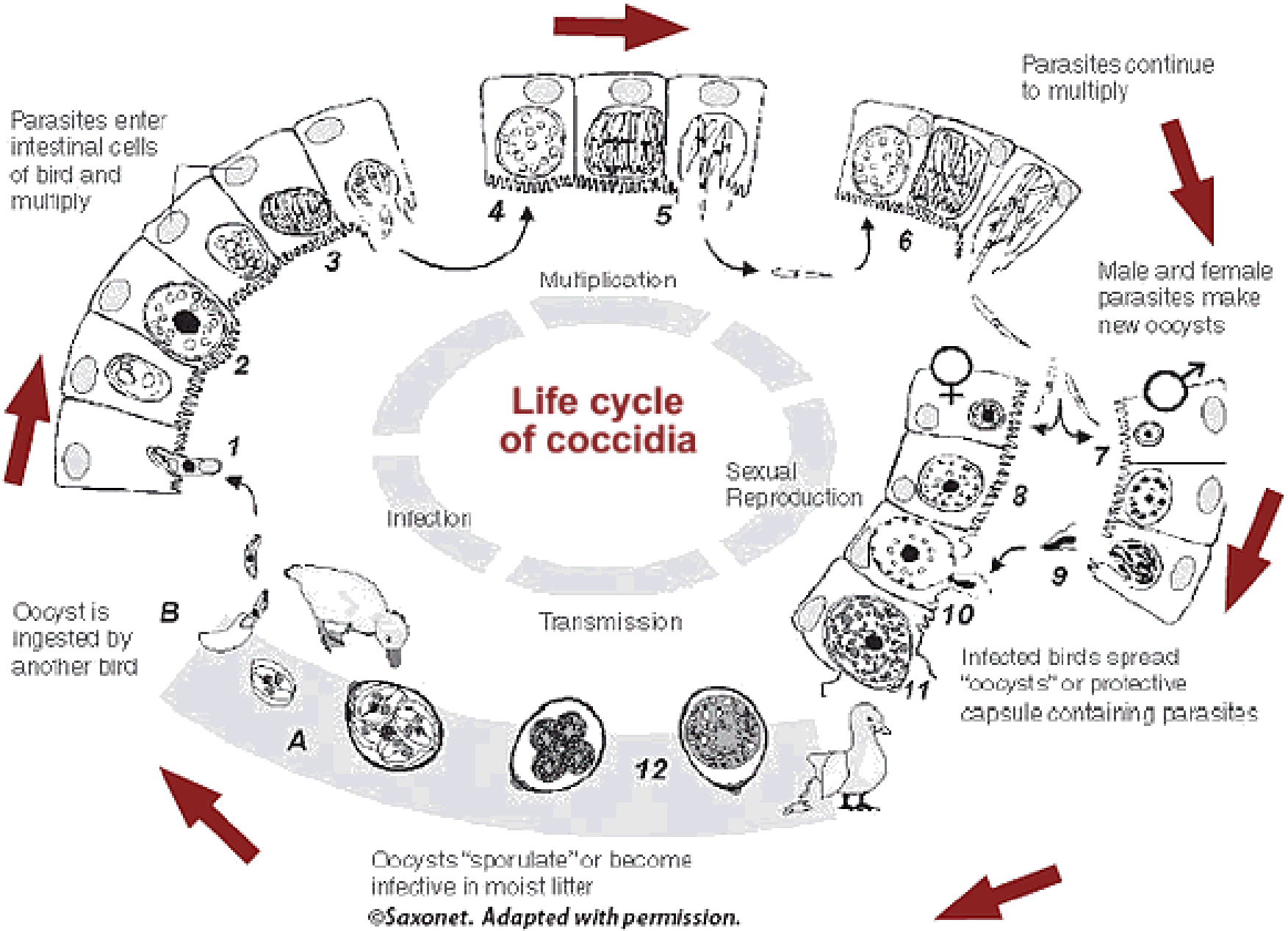


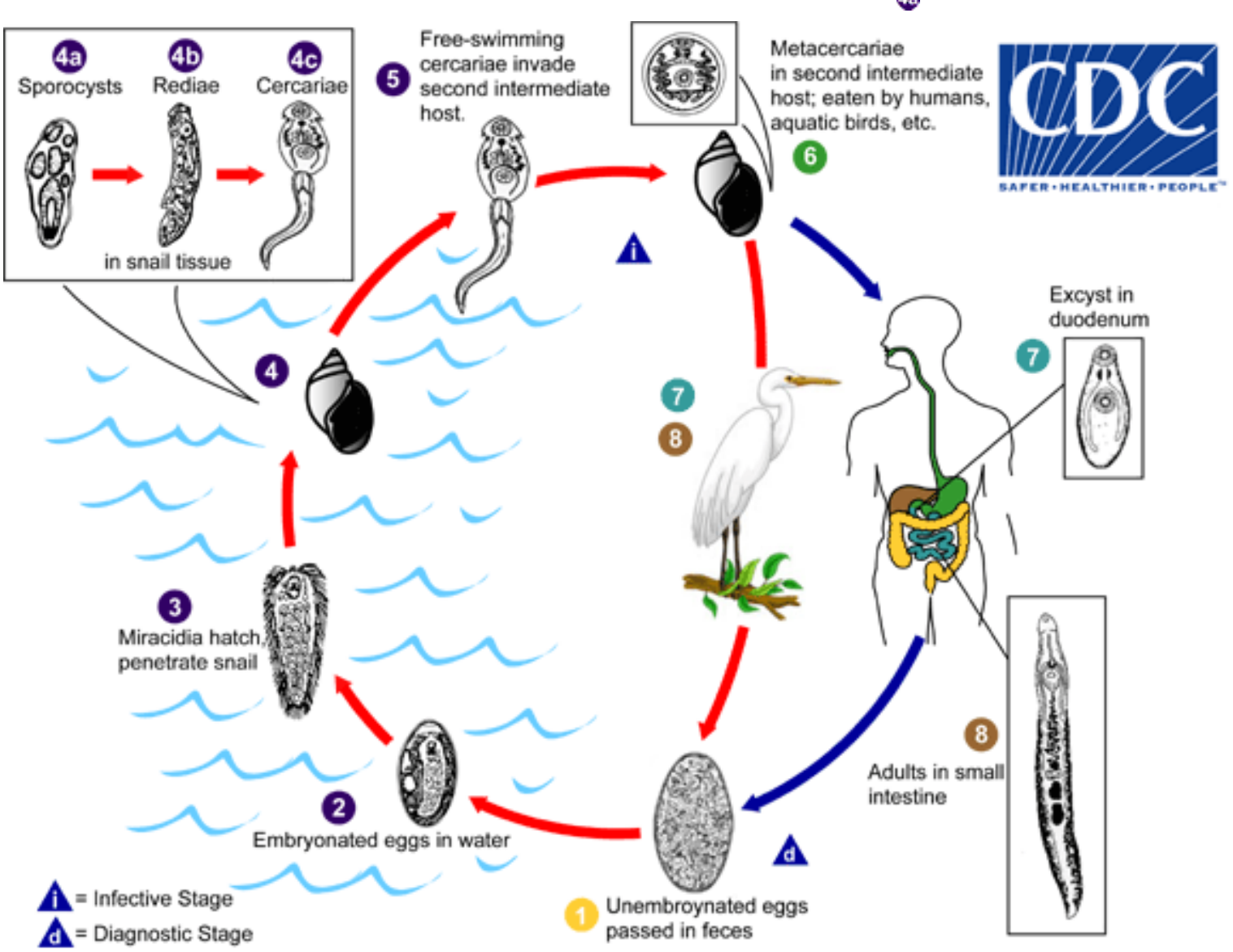
***Goblet and mast cells response during Echinostoma hortense* infection.**

"intestinal fluke of the class Trematoda, which has been found to infect humans in East Asiancountries such as Korea, China, and Japan."

Mast cells and histamine alter intestinal permeability during Plasmodium infection







Many animals may serve as definitive hosts for various echinostome species, including aquatic birds, carnivores, rodents and humans.