Al-Muthanna J. For Agric Sci Online ISSN:2572-5149

Print ISSN: 2226-4086

Vol. 13 , Issue 1. 2026

https://muthjas.mu.edu.iq/ http://doi.org/10.52113/mjas04/13.1/48

Histomorphological Study of Small Intestine with Identification and Expression of Stem Cells by Marker Gene Lgr5 in Local Neonatal Goats

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Abstract

Background: The small intestine plays a key role in food processing and absorption. Consists of the duodenum, jejunum, and ileum, which differ in their morphological structure and morphometry. Stem cells are specialized epithelial cells specifically designed to line the crypts and produce four intestinal cell types.

Aim: This study aimed to investigate the histological structures of the small intestine and the distribution and expression of intestinal stem cells (ISCs) in the small intestine of neonate goats. **Methods:** The study involved ten newborn local goats aged 1-7 days, obtained from healthy pregnant females. After separating them from their mothers, the goats were obtained from healthy pregnant female goats brought from the AL-Qasim livestock market and kept in a barn in the animal house of the College of Veterinary Medicine/University of Baghdad until their delivery, and tissue sections from their intestines were prepared and stained for analysis.

Results The study found that the small intestine structure in neonatal goats is similar to that of adult goats and other mammals, consisting of similar layers but differing in measurements. The mucosa has varying villus shapes and sizes, with more goblet cells in the ileum and specific cell types in different intestinal regions. Lgr5 is an intestinal stem cell marker used to locate stem cells through staining. In neonatal goats, ISCs were mainly located at the Lieberkühn crypt bases and extended along the villi, especially in the duodenum and jejunum. These findings emphasize the important role of ISCs in intestinal growth and renewal during development.

Conclusion The histological structure of neonatal goat small intestines resembles that of adults, with similar tunicae but varying measurements for absorption. Lgr5-positive stem cells were prevalent in the duodenum and jejunum, indicating high regeneration needs.

Keywords: Histology, Identification, Marker Lgr5, Neonate, Small intestine, Stem cells.

Introduction

The goat *(Capra hircus)* is a domestic animal distributed in many regions of the world and is one of the most important animals. Goat husbandry plays an important role in the economy of our country with special reference to milk, meat, manure, and hide production (Arora and Joshi, 2013). In developing countries, a number of large and small farmers rear goats for their livelihood (Singh, 2006). It is known as the ‘poor man‘s cow’ in India and as the‘wet nurse’ of infants in Europe (Iqbal *et al.*, 2008). Research on this species, especially its anatomy, has been largely neglected (Bhattarai, 2012). Therefore, a detailed study of the different aspects of goat anatomy is required. The selection of the species is based on the local inhabitance and the meager availability of literature on this quadruped.

ISCs are responsible for the continuous renewal and maintenance of the intestinal epithelium. They are located mainly at the base of the Lieberkühn crypts, where they undergo rapid proliferation to replace differentiated epithelial cells that are constantly shed from the villi surface (Barker, 2014). This high turnover ensures the small intestine’s structural and functional integrity throughout life.

Among the molecular markers used to identify ISCs, leucine-rich repeat-containing G-protein coupled receptor 5 (Lgr5) is widely recognized as one of the most specific and reliable markers. Lgr5-positive

cells act as multipotent stem cells, capable of generating all intestinal epithelial lineages. Their role in intestinal growth, repair, and regeneration is essential (Clevers, 2013).

The activity and distribution of ISCs vary according to developmental stages. Neonates exhibit rapid intestinal growth and functional adaptation after birth, requiring enhanced stem cell proliferation and differentiation. In contrast, adult animals display a more restricted ISC activity that maintains epithelial homeostasis rather than driving extensive growth (LiL, 2010). Such differences reflect the dynamic changes in intestinal physiology across the lifespan of the patients. Despite the biological importance of ISCs, research on their developmental distribution in goats has been limited. Investigating Lgr5-positive ISC expression in neonatal goats can provide valuable insights into intestinal development, regeneration, and species-specific physiology (Kraiczy, 2019). This knowledge may also contribute to advances in veterinary medicine and RB.

Aims of the study

Study the small intestine of three parts in the neonatal period of local goats to provide a database for researchers in the fields of nutrition and concern and to provide a valuable insight into intestinal biology in goats through the following:

1. Study the histological architecture of each small intestine segment of local goats during the neonatal period.

2. Distribution and expression of intestinal stem cells (ISCs) in small intestine segments of local goats during the neonatal period.

Materials and Methods

Healthy ten neonate goats were obtained from healthy pregnant female goats which brought from AL-Qasim livestock market and keep in barn in the animal house in the College of Veterinary Medicine/ University of Baghdad till their delivery, then separated from their mothers and euthanized, then transported and kept in animal house in the laboratory of department of anatomy and histology at the College of Veterinary Medicine/University of Baghdad to complete the routine histological technique. The representative samples of ($1C^3$) were cut from three parts of small the intestine.The specimens of small intestine parts were rinsed by normal saline(0.9٪) then directly fixed in neutral buffered formalin(10%) used for 48 hour, dehydrated by using a series of graded ethanol alcohol andthese specimens were cleared by

xylene(**Kashef***et al.*,2023).Samples of duodenum, jejunum and ileum were treated by paraffin embedding histological technique at 58-60C^0, the tissue meticulously sliced into thin ribbons in thickness of 5-6 µm paraffin segments was done by rotary microtome(khalealand Salman,2019;Batah,2019andZghairandKhal eel,2019). Stained with Harris's Hematoxylin and Eosin for general histological structure features and Masson's Trichrome stains for collagen fibers and smooth muscle fibers(Ghafil and Khaleel,2023),(Kadhimand Khaleel,2022; Mirhishand kareem,2015).The sections have been investigated using an Olympus microscope camera. The histometrical data of each small intestine segment werein a table and analyzed according to Suad*et al.* (2018).

Immunohistochemical for the stem cells:

Anti-Lgr5 antibody (US biological/USA) and Immuno Cruz™ rabbit LSAB staining system: sc-2051 (santacruz/USA) used as anintestinal stem cell marker for theidentification of stem cells in small intestine three parts; Paraffin-embedded intestinal tissue sections (4–6 µm) were mounted on gelatin-coated slides, deparaffinized, and rehydrated. Endogenous peroxidase activity was blocked, followed by incubation with the primary antibody anti-Lgr5. Sections were then treated with a biotinylated secondary antibody and avidin–biotin–peroxidase complex. Visualization was achieved using DAB chromogen, and sections were counterstained, dehydrated, and mounted.One primary antibody catalogue (Anti-Lgr5, US Biological, Cat. No. 170733) and one immunohistochemical staining kit catalogue (ImmunoCruz™ Rabbit LSAB Staining System, Santa Cruz Biotechnology, Cat. No. sc-2051) were used for the detection of intestinal stem cells. Lgr5-positive intestinal tissue was used as a positive control to confirm antibody reactivity. Negative controls were prepared by replacing the primary antibody with non-immune rabbit LgG or PBS to ensure specificity of staining.

Statistical analyses:

All numerical data are presented as mean ± SE, and one-way ANOVA was used to identify a significant difference at ($p < 0.05$).

Ethical approval

All study methods and preparations were approved (Approval No. PG/85)by the Animal Care and Use Committee of the Faculty of Veterinary Medicine, University of Baghdad, Iraq, on 12-1-2026.

Results

Duodenum

The duodenal wall is made of the tunica mucosa, submucosa, muscularis, and serosa (Fig. 1). The mucosa was thicker than the other tunicae that form the duodenal wall. The duodenal mucosa showed a number of villi that differed in shape and length and were covered by a simple columnar epithelium with a brush border and a few goblet cells (Fig. 1). The histological measurements are listed in Table 1. The height of the duodenal villi was higher than that of the jejunum and ileum. The lamina propria comprises the core of villi, which contains collagen fibers, fibrocytes, lymphocytes, and blood capillaries. Intestinal glands were present in the lamina propria and opened between the bases of the villi. They were simple, branched tubular glands lined with columnar epithelium with few goblet cells (Fig. 2). The Paneth cells were observed at the crypt bases as large, pyramidal cells or spherical cells with triangular tolarge rounded nuclei and occupied by acidophilic cytoplasmic granules (Fig. 2). The muscularis mucosa separated the mucosa from the sub mucosa (Fig. 2). The tunica submucosa contains lymphocytes, fibrocytes, collagen fibers, blood vessels, and Brunner's glands, which are specific for the duodenum only (Fig. 3). The Auerbach's nerve plexuses were similar to beads scattered linearly in the connective tissue between the smooth muscle bundles of the tunica muscularis' circular inner and longitudinal outer layers. Tunica serosa showed loose connective tissue with collagen and few elastic fibers (Fig. 1). Table 1 lists the histological measurements.

4.2 Jejunum

The jejunum wall comprises the same tunicae as the duodenum. The mucosa showed villi of various shapes and lengths and was covered by simple columnar epithelial cells with few goblet cells (Fig. 4). The villi shape was leaf –like and the density of goblets cells was higher than that in the duodenum. The crypts of Lieberkuhn were observed in the lamina propria, which also made up the core of the villi, and were similar to those observed in the duodenum (Fig. 4). Underneath the epithelium was the muscularis mucosa, which is made of smooth muscle fibers. Tunica submucosa was made from loose connective tissue, and Brunner glands were absent (Fig. 5). The tunica muscular was represented by inner circular and an outer longitudinal layer of

smooth muscle fibers, and myenteric plexuses were present between them (Fig. 5). The histological measurements are listed in (Table 1).

4.3 Ileum

Similar histological wall structures of the duodenum and jejunum were observed in the ileum, with a few differences, including the shape and length of the villi, which appeared as short leaf-like shapes with broad base villi covered by simple columnar and numerous goblet cells (Fig. 6). The histological measurements are listed in Table 1. The special feature of the ileum was the Peyer's patch, which extended from the lamina propria to the submucosa or muscularis layer (Figs. 6 and 7). The submucosa of the tunica was made from irregular collagenous connective tissue, cells, and blood capillaries (Fig. 7). Tunica muscularis made up inner circular and outer longitudinal of smooth muscle fibers, and Auerbach's plexuses were present between them (Fig. 7).

The statistical analysis showed that there were significant differences between the duodenum , jejunum and ileum at ($p < 0.05$) in the villi height, crypt depth, and thickness of the tunica mucosa, tunica submucosa, and tunica muscularis (Table 1).

2. Immunohistochemical analysis of stem cells

The Lgr5 stem cell marker was applied to study the expression and division of intestinal stem cells in the three segments of the small intestine (duodenum, jejunum, and ileum) in neonates. In general, the histological structure of the mucosa of the duodenum, jejunum, and ileum revealed that intestinal stem cells (ISCs) were found mostly at the bases of the villi (crypts of Lieberkühn) in inter-villus spaces, and the negative expression extended along the length of the villus . According to the region of the small intestine, the distribution of stem cell expression was highly expressed in the intestinal cells of the duodenum and in the jejunum, and mild expression was found in the intervillous spaces, whereas the ileum showed mild to moderate expression in the intestinal cells. The duodenal crypts showed high expression of Lgr5 (Fig. 9 &10). The jejunum showed high expression in crypt cells (Fig. 11, 12). The ileum showed high expression in the intestinal crypts or intervillous spaces in neonate goats (Fig. 13, 14). The present study demonstrates the clear distribution and expression of Lgr5-positive ISCs in the theneonatal period of goats.

Discussion

This study showed that the wall of the duodenum was made of the same four tunicae of the tubular digestive system mucosa, submucosa, muscularis, and serosa, and the mucosa was thicker. This result corresponds with that of Al-Saffar *et al*,.(2016).The duodenal mucosa showed numerous villi of different shapes and lengths, which were covered by simple columnar cells with a brush border with few goblet cells, as previously reported in local rabbits (Gallois *et al.,* 2004; Elnasharty *et al*., 2013). The lamina propria was made up of the core of villi containing collagen fibers and connective tissue elements and intestinal glands, which opened in between the bases of the villi and were lined by simple columnar epithelium with few goblet cells. This result agrees with that of Al-Saffar and Al-Zuhairy (2016) in neonatal cats. The paneth cells were observed as large, pyramidal cells or spherical cells with acidophilic cytoplasmic granules at the crypt bases. The muscularis mucosa, which is formed of smooth muscle fibers, separates the mucosa layer from the submucosa, similar to the observations reported by Al-Mansor (2018) in some animals. The tunica submucosa consists of loose connective tissue with Brunner's glands, which are specific for the duodenum only (Walthall *et al*., 2005; Al-Mansor, 2018) in gazelle and Angora rabbits (Furness *et al.,* 2006). The Auerbach's nerve plexuses were similar to beads that were linearly scattered in the connective tissue between the smooth muscle layers of the tunica muscularis, similar to that found in some laboratory animals (Kumar *et al.,* 2014). The tunica serosa showed loose connective tissue with collagen and few elastic fibers, as previously reported by Rajesh and Partha (2020).

This study revealed that the jejunum wall comprises the same tunicae as the duodenum.Mucosa showed villi of various shapes and lengths and were covered by simple columnar epithelial cells with a few goblet cells. This finding was consistent with that of AL-Saffar and Al-Zuhairy (2016) in neonatal cats. The villi shape and density of goblets cells were more than those in the duodenum. The crypts of Lieberkuhn occupied the lamina propria, which made up the core of the villi, and were similar to those observed in the duodenum. This finding was similar to that reported in rabbits by Gallois *et al.,* (2004) and in gazelle by Al-Mansor (2019). The muscularis mucosa was made of smooth muscle fibers, as reported in indigenous gazelle by Verdiglione and Filotto (2002).

Tunica submucosa was made from loose connective tissue and Brunner's glands were absent. This result disagreed with Castelucci *et al.* (2002) in pigs. This difference may be due to differences in the type of food consumed according to animal species. Moreover, the jejunum, being distal to the duodenum, does not experience direct exposure to highly acidic chyme and therefore does not require extensive alkaline mucus secretion, explaining the physiological absence of Brunner's glands in this segment. The tunica muscular was represented by inner and outer longitudinal layers of smooth muscle fibers, and myenteric plexuses were present between them. These results were similar to those reported by de Santa *et al*. (2003). Tunica serosa was a collagenous connective tissue, similar to the observation in local rabbits by Kumar *et al.* (2014).

The histological structure of the ileum wall was similar to that of the duodenum and jejunum in composing four tunicae. Leaf-like, short, broad-base villi project from the mucosa, which is covered by simple columnar cells and numerous goblet cells. Peyer's patches were a special feature of the ileum that extended from the lamina propria to the submucosa or muscularis layer. This finding agrees with that of Rajesh and Partha (2020) in rabbits.

The submucosa was made from irregular collagenous connective tissue, cells, and blood capillaries, while the tunica muscularis was made of two layers of smooth muscle fibers and Auerbach 's plexuses were located in between. This finding was similar to that reported by AL-Saffar and Al-Zuhairy (2016) in neonatal cats.

The statistical analysis of the histological measurements showed that there were significant differences at $p \leq 0.05$ among duodenum, jejunum, and ileum in terms of villus height, crypt depth, and mucosal, submucosal, and muscularis thickness. The duodenum exhibited the greatest villus height, crypt depth, mucosa submucosa, and muscularis compared with the jejunum and ileum, and the increase in villus height in the duodenum was associated with its primary role in the initial phase of nutrient absorption and subsequent gastric chyme entry. These results agree with the findings of Junqueira and Carneiro (2021), who reported that villus length directly correlates with the absorptive efficiency of the mucosal surface area. The jejunum demonstrated a significant increase in villi height compared with the ileum. This result

reflects the structural adaptation of Jujenum, which supports its function in mechanical mixing and luminal content propulsion. These findings agree with those of Young and Heath (2020). The ileum exhibits fewer and shorter villi, similar to that observed in rabbits by Eurell *et al.* (2006). This result reflects that the function of the duodenum was secretion of enzymes and absorption, whereas the jejunum and ileum were responsible for rapid nutrient absorption and immune function, respectively .The current study investigates the significant differences in crypt depth between the duodenum, jejunum, and ileum. These differences are due to the differences in their functions. The duodenum is responsible for secretion and absorption, while the jejunum is responsible for absorption and mixing of nutrients. The ileum performs immune function, and the crypts represent the site of renewal of villi epithelium. Significant differences in the sub mucosal thickness of the duodenum compared with the jejunum and ileum due to the presence of Brunner's glands. The present study recorded significant differences in the muscular layer of the jejunum. This finding was parallel with the finding of Young and Heath (2020), who reported that the jejunum has a muscular layer that is more developed to increase peristaltic movement. The ileum showed the shortest villi, shallow crypts, and reduced mucosal thickness, reflecting its specialized role in bile salt and vitamin B12 absorption rather than broad nutrient absorption.

This study demonstrates the clear distribution and expression of Lgr5-positive intestinal stem cells (ISCs) in goats during the neonatal period. Lgr5 expression was detected only at the crypt bases, but Lgr5 expression was negative and extended along the villi in the duodenum jejunum and ileum. This finding reflects the high proliferative activity required for rapid intestinal growth and functional adaptation during the neonatal stage. Similar patterns of extended stem cell expression in early life have been reported in other mammals, where increased stem cell activity supports intestinal maturation and expansion after birth (Barker *et al*., 2007; Yan *et al*., 2012). Among the intestinal segments, the jejunum exhibited mitotic activity, that the jejunum maintains a central role in epithelial renewal, possibly due to its functional importance in nutrient absorption. Previous studies have shown that the jejunum harbors a higher density of proliferative stem and progenitor cells than other intestinal regions, supporting its role as a primary site of epithelial regeneration (Clevers, 2010). The differences observed in neonatal goats

highlight the dynamic regulation of ISCs in response to developmental and physiological needs. The high neonatal expression of Lgr5 across crypts underscores the need for rapid epithelial expansion. These findings are consistent with reports that stem cell activity is developmentally regulated and adapts to the metabolic and absorptive demands of the organism (Kraiczy, 2019). Immunohistochemical analysis of small intestine stem cells in a neonate goat showed that intestinal stem cells are confined to the crypt base, and no stem cells were observed on the villus surface, which was lined by differentiated epithelial cells migrating from the crypts.The crypt-restricted distribution of intestinal stem cells, which ensures continuous epithelial renewal during early postnatal development, is a conserved feature across mammalian species, including neonatal ruminants (Clevers, 2013; Barker *et al.,* 2010).

Conclusion

The study demonstrated that the general histological structure of the small intestine in neonatal goats is similar to that of adults, with differences in histological measurements reflecting functional adaptation. These variations are related to the type and extent of intestinal absorption.Lgr5-positive intestinal stem cells were more widely distributed in crypts, particularly in the duodenum and jejunum. The jejunum exhibited high mitotic activity, highlighting its key role in intestinal renewal during early development.

FUNDING

None funding

AUTHORS' CONTRIBUTIONS

Asaad Hillawi Enad Conceptualization; Data curation; Investigation; Methodology; Project administration; Original draft writing; Review and editing.

Iman Mousa Khaleel: supervision, validation, writing, review, andSupervision; Validation; Writing - review and editing.

Acknowledgment

The authors want to thank prof. We thank Dr. Iman Mousa Khaleel for her great efforts and valuable scientific guidance in the completion of this research and Dr. Noor Hussein for her support in the Department of Anatomy, Histology and Embryology, College of Veterinary Medicine, University of Baghdad.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

DATA AVAILABILITY

Data are available within the article.

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Figures legends

Fig.1: Histological section of duodenum in neonate goats shows: Mucosa (M), Submucosa(Sb), Muscularis(M),Serosa(S) Villi(V), Epithelium(E), Goblet cells(G) H&E Stain 10X.

Fig. 2: Histological section of duodenum in neonate goats shows: gobletcells(blackarrows)H&EStain 10X

Fig. 3: Histological section of duodenumin neonate goats showing: Crypts of Lieberkuhan (Cr), Collagen fibers (C), Paneth cells (blue arrows) and Laminapropria(LP): H&EStain 40X

Fig. 4: Histological section of duodenum in neonate goats shows:Brunner's glands (B), and Laminapropria (LP):H&E Stain 20X

Fig.5: Histological section of Jejunumin neonate goats shows:Villi(V),Crypts of Lieberkühn (Cr): H&EStain10X

Fig.6: Histological section of Jejunumin neonate goats showsserosa(green arrow) inner circular muscle and outer longitudinal muscle(yellow arrow),submucosa (blue arrow) H&E Stain20X

Fig.7: Histological section of ileumin neonate goats shows: Villi (V), simple columnar epithelium(E)Goblet cells (G), H&EStain40X

Fig.8: Histological section of ileumin neonate goats shows the layers of the ileum Serosa (S),Muscularis(M) Submucosa(Sb), Myentric Plexus(red arrow):H&EStain10X

Fig.9: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows high expression of Lgr5 at the bases of crypts (red star) and Lgr5- ve in the villi (yellow star) Lgr5. 100X.

Fig.10: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows high expression, shows Lgr5+ve at bases of crypts (blue star) Lgr5. 400X

Fig.11: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows high expression of Lgr5 at the at bases of crypts (red star) Lgr5. 100X

Fig.12: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows its high expressionLgr5 at the at bases of crypts (red star) Lgr5. 400X

Fig.13: Histological section of ileum in neonate goats. Immuno-histochemical staining with Lgr5 marker, shows Lgr5+ ve at bases of crypts (yellow arrows) and Lgr5- ve villi (blue star) Lgr5. 100X.

Fig.14: Histological section of ileum in neonate goats shows Immuno-histochemical staining with Lgr5 marker, shows Lgr5+ ve at bases of crypts and Lgr5- ve villi (orange arrows) Lgr5. 400X

Table 1:The epithelial height, villi height crypts depth, ratio villi height/ crypt depth and thickness of tunicae of the Duodenum, Jejunum and Ileum represented as Mean± SE(µm).

Parameter	Duodenum	Jejunum	Ileum
Epithelial Height	**25.5±0.935** A	**25.312±2.236** A	**25±1.741** A
Villi Height	**390±9.797** A	**360±18.708** B	**264±9.65** C
Crypts Depth	**252.5±23.523** A	**204±16.298** B	**135.5±7.770** C
Ratio Villi Height/ Crypt Depth	**1.544±424** A	**1.764±1.201** A	**1.948±1.321** A
Tunica Mucosa Thickness	**645±28.740** A	**593±18.275** B	**426±5.830** C
Tunica Submucosa Thickness	**203±3.741** A	**194±2.236** B	**187±5.385** B
Tunica Muscularis Thickness	**203±12.083** A	**231±2.449** B	**200±5.099** A
Tunica Serosa Thickness	**42±2.236** A	**42±2.236** A	**43±2.236** A

Horizontally, different capital letters showed significant differences at the level of ($p < 0.05$).

Fig.1: Histological section of duodenum in neonate goats shows: Mucosa (M), sub mucosa (Sb), Muscularis (M),Serosa(S) Villi(V), Epithelium(E), Goblet cells(G) H&E Stain 100X

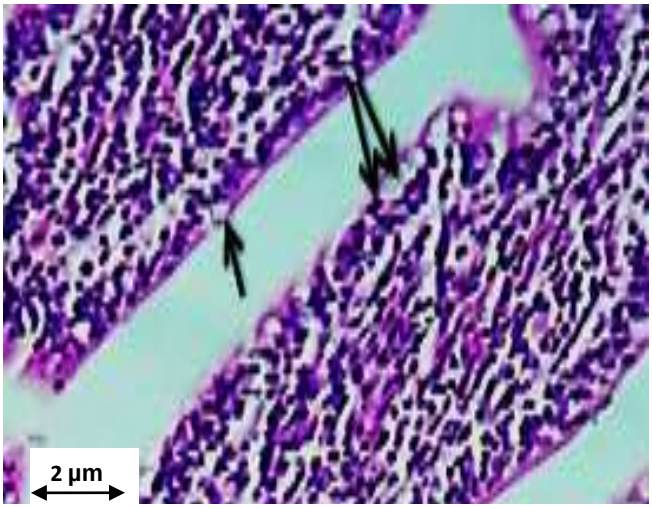

Fig. 2: Histological section of duodenum in neonate goats shows: goblet cells(black arrows) H&E Stain 100X

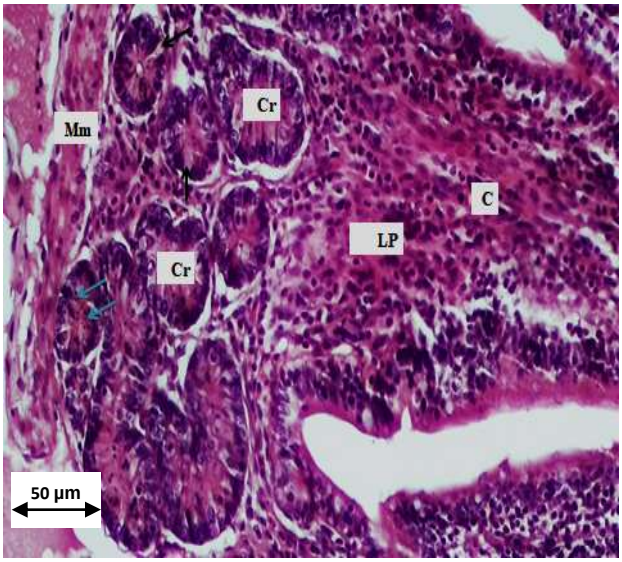

Fig. 3: Histological section of duodenum in neonate goats shows: Crypts of Lieberkuhan (Cr), Collagen fibers (C), Paneth cells (blue arrows), Muscularismucasa (Mm) and Lamina propria (LP): H&E Stain 400X

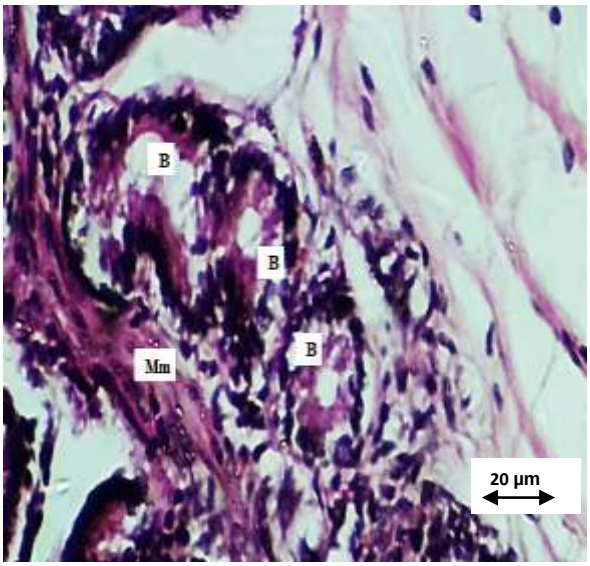

Fig. 4: Histological section of duodenum in neonate goats shows:Brunner's glands (B), Muscularis mucosa and (Mm):H&E Stain 200X

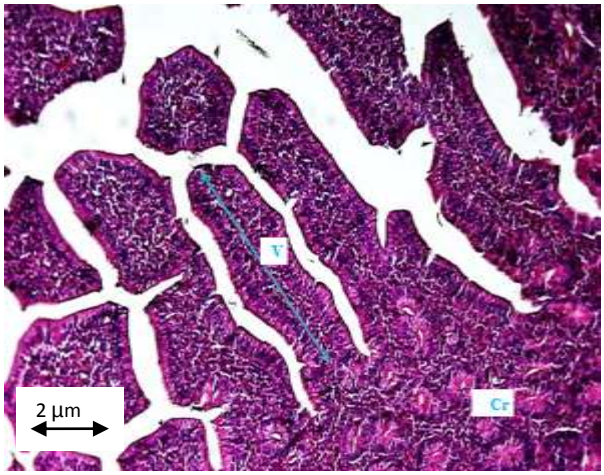

Fig.5: Histological section of Jejunum in neonate goats shows: Villi (V), Crypts of Lieberkühn (Cr): H&E Stain100X.

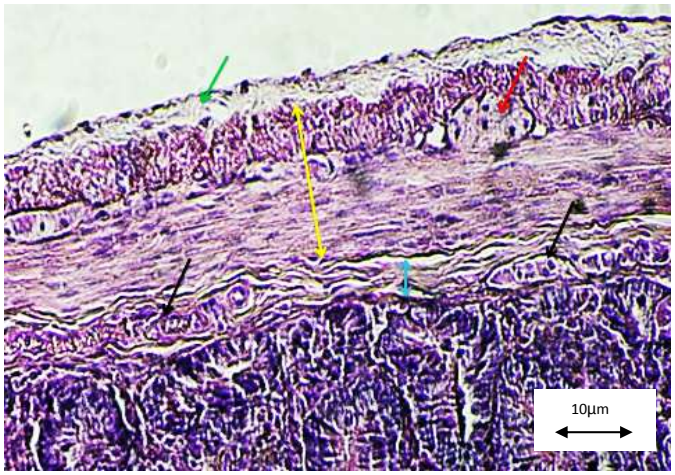

Fig.6: Histological section of Jejunum in neonate goats shows serosa (green arrow) inner circular muscle and outer longitudinal muscle(yellow arrow),Submucosa (blue arrow) H&E Stain 200X.

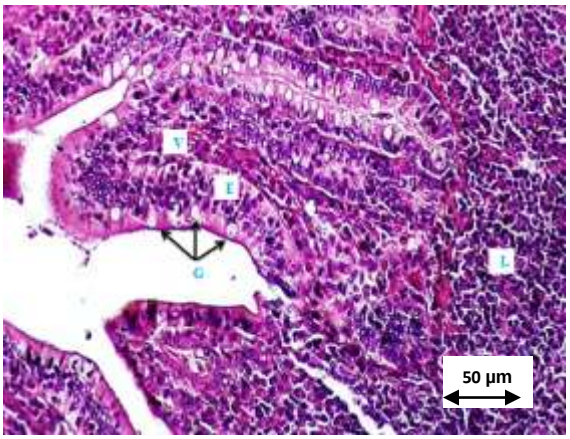

Fig.7: Histological section of ileum in neonate goats shows: Villi (V), simple columnar epithelium(E)Goblet cells (G), H&E Stain 400X

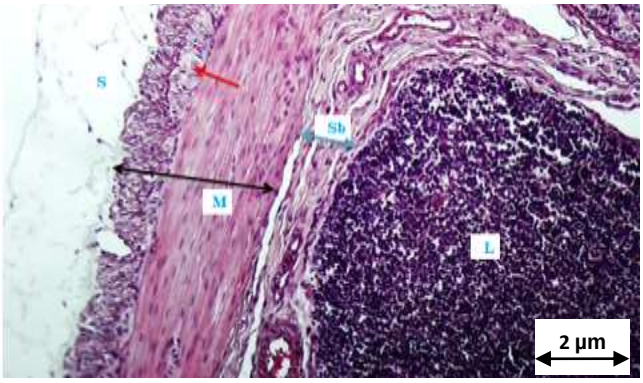

Fig.8: Histological section of ileum in neonate goats shows the layers of the ileum Serosa (S), Muscularis (M) Submucosa (Sb), Myentric Plexus (red arrow): H&E Stain100X

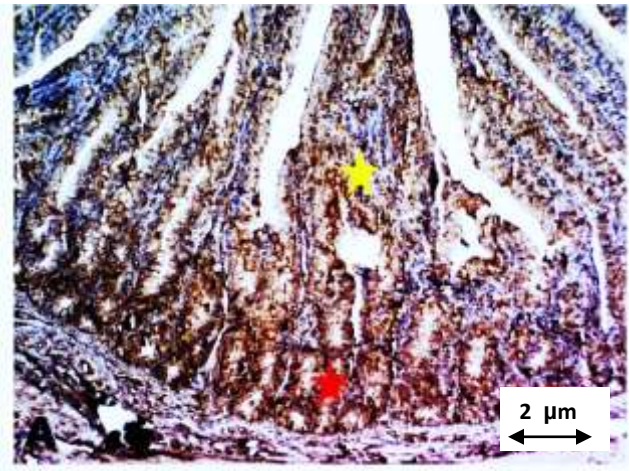

Fig.9: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows high expression of Lgr5 at the bases of crypts (red star) and Lgr5- ve in the villi (yellow star) Lgr5. 100X.

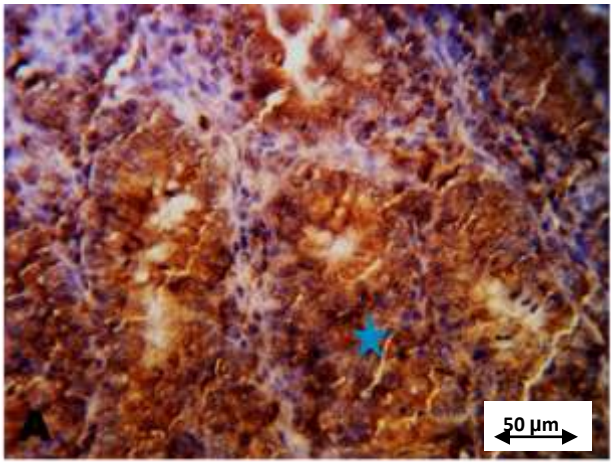

Fig.10: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows high expression, shows Lgr5+ve at bases of crypts (blue star) Lgr5. 400X.

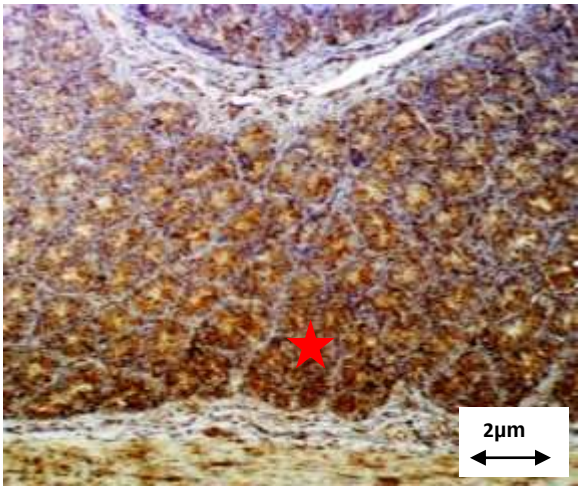

Fig.11: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows high expression of Lgr5 at the at bases of crypts (red star) Lgr5. 100X.

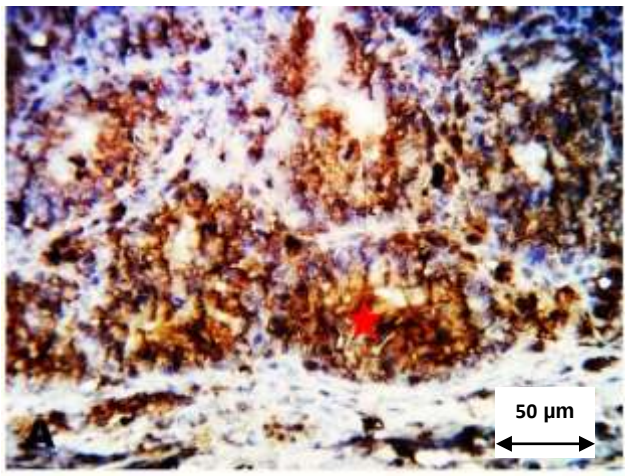

Fig.12: Immuno-histochemical staining of the section of the duodenum in neonate goats with Lgr5 marker, shows its high expressionLgr5 at the at bases of crypts (red star) Lgr5. 400X

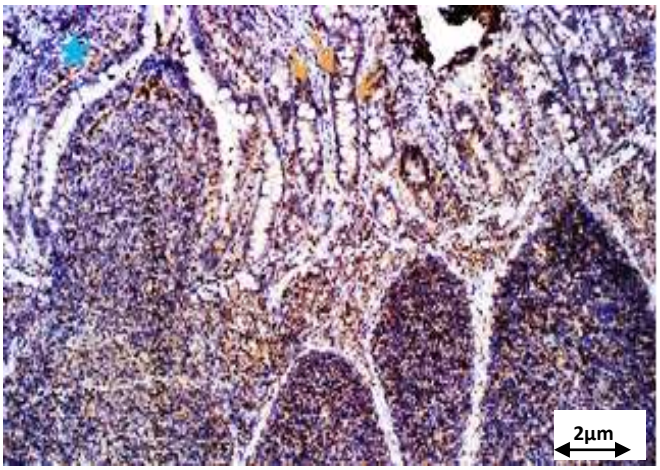

Fig.13: Histological section of ileum in neonate goats. Immuno-histochemical staining with Lgr5 marker, shows Lgr5+ ve at bases of crypts (yellow arrows) and Lgr5-vevilli (blue star) Lgr5. 100X.

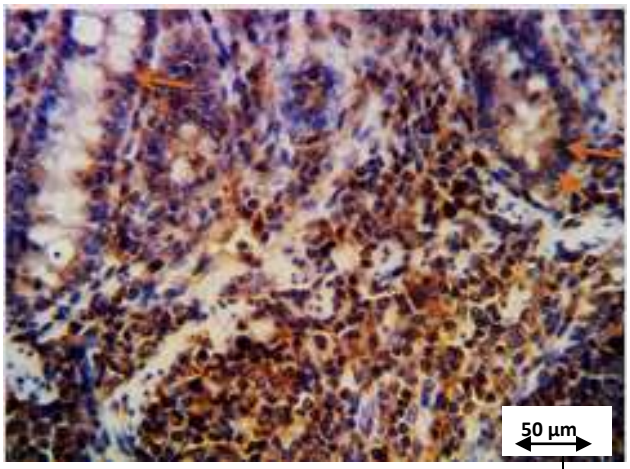

Fig.14: Histological section of ileum in neonate goats shows Immuno-histochemical staining with Lgr5 marker, shows Lgr5+ veat bases of crypts and Lgr5-vevilli (orange arrows) Lgr5. 400X.