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RESEARCH ON INTESTINAL MORPHOLOGICAL CHANGES, IN CORRELATION WITH THE AMOUNT OF COLOSTRUM CONSUMED BY PIGLET NEWBORN

CERCETĂRI PRIVIND MODIFICĂRILE MORFOLOGICE INTESTINALE, ÎN CORELAȚIE CU CANTITATEA DE COLOSTRU CONSUMATĂ DE PURCELUL NOU-NĂSCUT

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ABSTRACT | REZUMAT

In the paper are presented the results obtained from research on changes of the morphology in the intestines in piglets with different weights at farrowing, in correlation with the amount of colostrum ingested in the first 24 hours after farrowing. To carry out the present research, the following parameters were monitored: weight at farrowing, disinfection at the level of the farrowing box, the health status of the sow, and the amount of colostrum ingested by the piglet in the first 24 hours after farrowing. The piglets from the experimental group, taken into the study, came from three sows housed in the same housing and the same conditions as the piglets of the sow from the control group, the difference between the two groups being that the pens in which the sows from the experimental group were held, the disinfection was carried out superficially, while in the pens of the control batch, the disinfection was adequate. Piglets in the experimental group differed among themselves in farrowing weight and the amount of colostrum ingested in the first 24 hours. The results regarding the intestinal morphological changes show that the size of the intestinal villi at three days of age was correlated with the body mass at farrowing, and the amount of colostrum ingested in the first 24 h as follows: for the piglets in the experimental group, the small intestine showed changes, in correlation with the amount of colostrum ingested in the first 24 h. Thus, to piglet weighing 700 grams at farrowing that consumed 100 g of colostrum in the first 24 h, the small intestine showed a morphology similar to that of the piglet from the control group (900 g at farrowing and with 200 g of colostrum ingested in the first 24 h of life). In the case of the other two piglets in the experimental group, that consumed around 50 g of colostrum in the first 24 h having weights, one of 700 g and the other of 800 g at farrowing, the intestinal lesions were much more severe, lesions that allowed the onset of diarrhoea, in the first 3 days of life, in the case of the piglet that weight 800 g at farrowing.Piglets that were underweight at farrowing, consuming amounts of colostrum below 100 g in first 24 h, at the age of 3 days showed changes in the small intestine that lead to metabolic disturbances and implicitly to their underdevelopment.

Keywords: piglet farrowing weight, colostrum ingested, small intestine

În lucrare sunt prezentate rezultatele obținute în urma cercetărilor privind modificările morfologice intestinale la purcei cu greutăți diferite la fătare, în corelație cu cantitatea de colostru ingerată în primele 24 de ore după fătare. Pentru realizarea prezentelor cercetări au fost monitorizați următorii parametrii: greutatea la fătare, dezinfecția la nivelul boxei de fătare, starea de sănătate a scroafei și cantitatea de colostru ingerată de purcel în primele 24 de ore după fătare. Purceii din lotul experimental, luați în studiu, au provenit de la trei scroafe cazate în același adăpost și aceleași condiții cu purceii proveniți de la scroafa din lotul martor, diferența dintre cele două loturi constând în aceea ca la boxele în care au fost cazate scroafele din lotul experimental, dezinfecția s-a realizat superficial, în timp ce la boxa lotului martor dezinfecția a fost una corespunzătoare. Purceii din lotul experimental au diferit între ei prin greutatea la fătare și cantitatea de colostru ingerată în primele 24 de ore. Rezultatele privind modificările morfologice intestinale arată că mărimea vilozităților intestinale la vârsta de trei zile au fost în corelație cu masa corporală la fătare și cantitatea de colostru ingerată în primele 24 de ore după cum urmează. La purceii din lotul experimental, intestinul subțire a prezentat modificări (în grade diferite), în corelație cu cantitatea de colostru ingerată în primele 24 de ore. Astfel la purcelul cu greutatea de 700 de grame la fătare care a consumat 100 de grame de colostru în primele 24 de ore, intestinul subțire a prezentat o morfologie asemănătoare cu a purcelului din lotul martor (900 de grame la fătare și cu 200 de grame de colostru ingerat în primele 24 de ore). La ceilalți doi purcei din lotul experimental care au consumat în jur de 50 de grame de colostru în primele 24 de ore având greutăți, unul de 700 de grame și celălalt de 800 grame la fătare, leziunile intestinale au fost mult mai grave, leziuni care au permis instalarea diareii, în primele 3 zile de viață, la purcelul de 800 grame. Purceii care au fost subponderali la fătare, care consumă cantități de colostru sub 100 grame în primele 24 ore, la vârsta de trei zile au prezentat modificări ale intestinului subțire care duc la perturbări metabolice și implicit la subdezvoltarea acestora.

Cuvinte cheie: greutatea purceilor la fătare, colostru ingerat, intestin subțire

In intensive pig farming, obtaining a large number of piglets at one farrowing is a major objective. At the same time, weaning as many piglets as possible from a sow is

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also a major objective. In order for weaned piglets to express their full biological potential, it is necessary that from farrowing they meet minimum requirements to support production capacity.

Among these requirements, a major role is played by the weight at farrowing, as well as the ingestion of a minimum amount of colostrum, in the first 24 hours, which will contribute and support the realization of the biological potential.

If these requirements are not met, there is a risk of keeping some piglets in the maternity ward that may become vulnerable either to primary infections (bacterial, viral) or to conditional infections that may occur as a result of increased microbial loads in the farrowing pens, predisposing the piglets to digestive infections, more often, in the first phase, and later for respiratory infections (2, 3, 11, 14, 15).

The present research aimed to study the implication and influence of piglet weight at farrowing and colostrum consumption in the first 24 hours on the development of piglets in the first week of life, in correlation with the reduction of microbiota load in the farrowing pens, in order to be able to implement measures to supports the improvement of the productive performance of newborn piglets.

Given that the body development of piglets in the first weeks of life is closely correlated with the integrity of the digestive tract, the integrity of the intestinal mucosa was assessed in the piglets studied by analysing the integrity of the intestinal villi.

MATERIALS AND METHODS

In order to achieve the proposed goal, four categories of piglets (control and 3 categories of experimental piglets) were studied to measure the height of the intestinal villi, which were monitored from the time of birth until the age of three days, in terms of weight and consumption of colostrum in the first 24 hours.

The specimens included in the present research were selected to be included in the study, based on farrowing weight and the amount of colostrum ingested in the first 24 hours of life as follows:

- The control piglet was in good body condition and weighed 900 grams at farrowing, and ingested 200 grams of colostrum;
- The first piglet weighed 700 grams at farrowing and ingested 100 grams of colostrum
- The second piglet weighed 700 grams at farrowing and ingested only 50 grams of colostrum;
- The third piglet weighed 800 grams at farrowing, ingested only 50 grams of colostrum, and presented with diarrhoea on the third day of life.

Each specimen taken in the study was slaughtered on the third day postpartum. Immediately after, the gastrointestinal tract was collected and gut fragments from the middle part of the duodenum, jejunum, and ileum (approximately 1 to 2 cm in length) were taken. Immediately after, the intestinal fragments were fixed in 80 volumes of isopropyl alcohol and stored at 4°C for transport from the farm to the laboratory. In the laboratory, the samples were processed to obtain histological preparations. Cross-sections of intestinal samples were fixed in 4% paraformaldehyde for 24 h and then embedded in paraffin wax. Sections of 5 µm thickness were cut and stained with haematoxylin-eosin. On the histological preparations thus obtained, the height of the villi and the depth of the crypt were determined, in the three intestinal segments: duodenum, jejunum, and ileum. In each tissue cross-section, at least six complete villus-crypt structures were examined under the microscope, and villus height and crypt depth were measured using the analysis system built into the Olympus CX 41 microscope.

RESULTS AND DISCUSSION

The obtained results are presented in summary in Table 1 and Figure 1.

Table 1

The average length of intestinal villi (µm)

Specification	Duodenum	Jejunum	Ileum
The witness pig	250.8	910.3	241.5
Piglet no.1	414.2	891.7	237.7
Piglet no.2	426.4	170.0	175.4
Piglet no.3	311.3	366.3	123.3

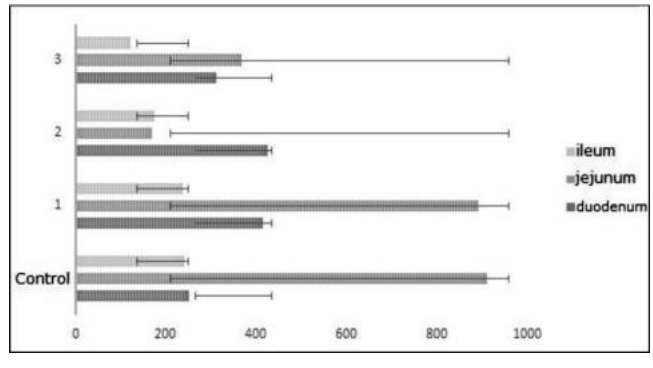

Fig. 1. The average length of intestinal villi

Following the investigations carried out on the samples collected from the control piglet, it was found that it wasn't shown any changes in none of the examined intestinal samples, that would signify alterations of the examined intestinal portions (duodenum, jejunum, and ileum). The appearance of the section and the size of the villi were located within normal limits, corresponding to the age of the piglet (Table 1, Fig. 1). As known from the literature, in piglets the length and width of the intestinal villi, the depth of the

crypt, and the thickness of the mucosa increase from day 0 to day 3 and decrease from day 3 to day 14. In addition, villus density decreases from day 0 to day 14 in the duodenum and from day 0 to day 3 in the jejunum. Finally, the surface area of the absorptive zone increases nearly 3-fold in the duodenum from day 3 to day 7 and doubles in the fasting state during the same period (1, 6, 7, 8).

Regarding the amount of colostrum consumed by piglets in the first 24 hours, the specialized literature mentions that the intake of colostrum represents 0.86 - 0.88% of the variation in the individual growth of the piglets' body weight, which means that the body mass of the litter in the first 24 hours after farrowing, is closely correlated with the amount of colostrum consumed by each piglet in the first 24 hours and with the amount of colostrum produced by the sow (13).

The results obtained at **piglet no.1**, who weighed 700g at farrowing, and ingested 100 grams of colostrum in the first 24 hours, show that changes occurred in the examined intestinal segments that changed the intestinal architecture.

At the duodenal level, the results revealed the installation of some structural changes at the level of the mucosa, with the appearance of leukocyte infiltrations in the axis of the intestinal and periglandular villi. Zonal detachments of the duodenal villi caused their atrophy. Atrophy determined the change in the length of the villi, in the sense of shortening, therefore the multiplication of basal cells can no longer compensate for the loss of epithelial cells (Table 1, Fig. 1). These changes lead to a reduction in the intestinal absorption capacity, from where, in addition to a lack of nutritional intake, a defence reaction also occurs, characterized by extravasation of liquid. From here, along with the presence of some germs, even non-pathogenic ones, it can result in the appearance of diarrhoea, a reason to have a reduced microbial load in the farrowing stalls, a fact that can be obtained through timely disinfection, the aim is to reduce the microbial load in the stall of farrowing (13, 18, 19).

Following the microscopic examination of the jejunum, the leukocyte infiltrate was highlighted, which was present from the level of the submucosa, up to the axis of the villi, with leukocytes located including interepithelial. In certain areas of the submucosa, leukocytes have thronged and formed lymph nodules, to these changes, it was observed the dilatation (ectasia) of milk vessels. In the ileum, the results of the microscopic examination revealed the installation of oedematous phenomena at the level of the submucosa, alterations at the level of the intestinal villi, as well as additional lymphocytic infiltrations, all these changes being of low intensity.

At piglet no. 2 (the piglet weighing 700 g, at farrowing, but which consumed only 50 grams of colostrum in the first 24 hours) following the microscopic examination of the duodenum, the results revealed structural changes similar to piglet no. 1, but more accentuated, a fact that was expressed by the atrophy of the intestinal villi and by their uneven lengths. The leukocyte infiltrate was more extensive, and included, in this case, the axis of the villi, reaching the level of the epithelium, the periglandular area, the lamina propria, and the submucosa. Also, the appearance of oedematous phenomena, located in the villous axis, peritubular, in the lamina propria and submucosa, was noted.

The results obtained during the microscopic examination of the jejunum showed the absence of intestinal villi (Table 1, Fig. 1) on the entire surface of the jejunal mucosa, where only the right tubular glands were present. Oedema phenomena were present, with oedema located at the level of the submucosa, lamina propria, and periglandular, accompanied by vascular ectasias. The leukocyte infiltrate was also present, extending to the submucosa and periglandular.

Also, the results regarding the microscopic examination of the ileum in the same piglet revealed the installation of oedema at the level of the tubular glands, with leukocyte infiltrate. For the most part, the intestinal villi had a normal appearance, but there were extensive areas where they were barely visible because atrophy had set in.

Data from the specialized literature show that the gastrointestinal system undergoes changes in the first 3 days after farrowing (9, 10, 13), and support the idea that once the first 12 hours pass after farrowing without ingesting a sufficient amount of colostrum, irreversible morphological changes occur at the intestinal level (9, 20).

Some studies show that if piglets (7) for various reasons fail to consume colostrum/milk in sufficient quantities (70 grams versus 330 grams) they die within the first 5 days after farrowing, the piglets that died consumed much less colostrum than the survivors. Therefore, piglets consuming less colostrum are less vigorous and less able to compete for suckling and are therefore more likely to die from hypothermia and/or malnutrition (6, 11, 15, 18).

At piglet no. 3 (the piglet weighing 800 g at farrowing, but which consumed only 50 grams of colostrum in the first 24 hours and presented diarrhoea on the third day of life) the results of the microscopic examination of the duodenum, in addition to piglet 1 and 2, the appearance of necrosis at the level of the duodenal villi, with a total change in architecture. Also, the leukocyte infiltrate was extensive, being present from the surface of the epithelium, intercellular, periglandular, in the lamina propria, and to the level of the submucosa. In this case, the installation of oedema was also found at the level of the right tubular glands.

Following the microscopic examination of the jeju-

num (Fig. 2 and Fig. 3), the results highlighted the massive destruction of the intestinal villi, with a significant reduction in architectonics. Thus, detachments of intestinal villi accompanied by necrosis of epithelial cells could be observed. And in this case, the presence of the oedematous phenomenon was found, more evident at the level of the submucosa.

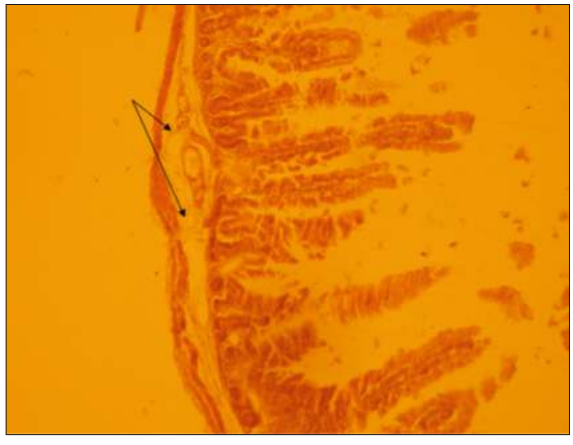

Fig. 2. Histological section through the jejunum: oedema (→), col HE, 100X

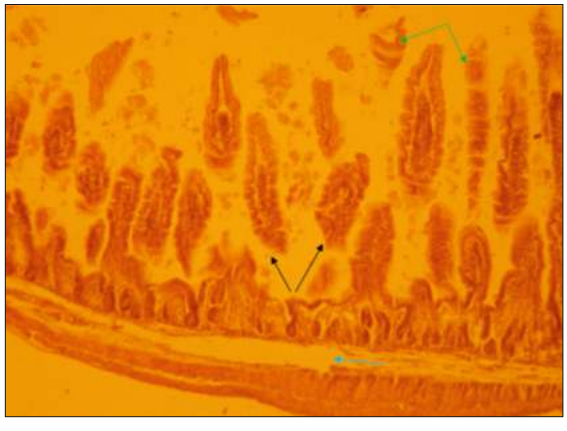

Fig. 3. Histological section through the jejunum: detachments of intestinal villi (→), epithelial necrosis (→), oedema (→), col HE, 200X

The results regarding the microscopic examination of the ileum in the same piglet (Fig. 4 and Fig. 5) revealed the atrophy of the intestinal villi, as a striking aspect, accompanied by massive leukocyte infiltrations. In this case, too, the installation of a periglandular oedematous phenomenon was also found in the lamina propria.

The results obtained in the piglets investigated in the present study are similar to other studies (12, 15, 17), they demonstrate that if the ingestion of a minimum amount of colostrum in the first 24 hours after farrowing is deficient, it results in intestinal morphostructural changes, which can either generate diarrhoea (the piglet no. 3) or alters the intestinal absorption capacity, thus reducing the biological performance of piglets deprived of colostrum consumption.

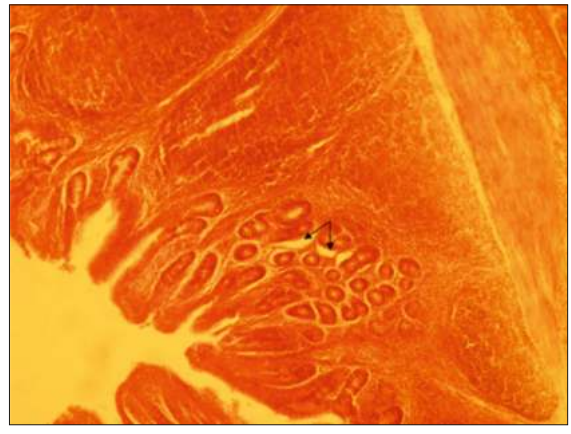

Fig. 4. Histological section through the ileum: periglandular edema (→), col HE, 100X

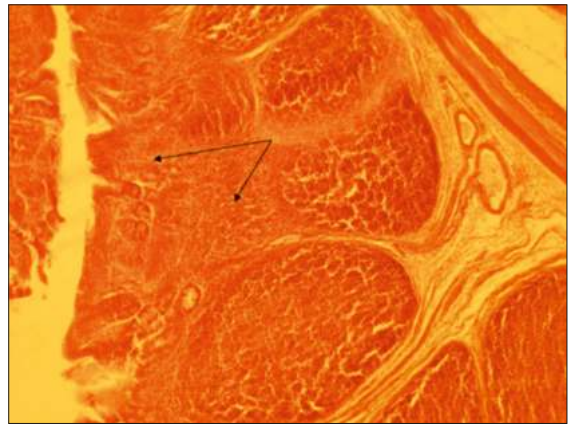

Fig. 5. Histological section through the ileum: periglandular leukocyte infiltrate (→), col HE, 100X

It is mentioned in the literature that all segments of the small intestine lose their ability to transport macromolecules, 36 hours after farrowing (1, 4, 8, 16, 18).

Some authors (10, 17, 20), claim in a study carried out on a batch of three-day-old piglets that there was a 72% increase in intestinal weight, which occurred on the first day, and this was primarily due to the increase in the weight of the mucosa by 115%. Associated with the increase in tissue weight was a 24% increase in small bowel length and a 15% increase in small bowel diameter. There is also a 33-90% increase in villus height and a 14-51% increase in villus diameter on the first day in the batch that was fed a sufficient amount of colostrum. There is also an effect of improving absorption and normal growth when supplementing the diet with lipopolysaccharides (10, 14, 16, 17).

In intensive piglet-rearing systems, a correlation can be observed between the performance of rigorous disinfection, the amount of colostrum ingested and pi-

glet weight at farrowing (1, 5, 9, 10, 12, 15, 19).

The mentioned studies show that each of these factors must be controlled because although a piglet ingests a sufficient amount of colostrum, having a lower weight at farrowing, correlated with the existence of pathogenic factors in the environment, pathological processes can be triggered at the level gastrointestinal (piglet no. 1), also without having a sufficient amount of ingested colostrum, the effect of underdevelopment of the intestinal segments is observed and thus the susceptibility to diarrhoea,a phenomenon observed in the case of piglet no. 3.

CONCLUSIONS

The obtained results show that in newborn piglets, intestinal integrity assessed by measuring intestinal villi is correlated with the weight of the piglet at farrowing, and the amount of colostrum ingested in the first 24 hours after farrowing.

If underweight piglets cannot ingest at least 100 grams of colostrum, there is a risk of unwanted changes in the architecture of the intestinal segments leading to a predisposition to diarrhoea and impaired intestinal function. The degree of change in intestinal villi is inversely proportional to the piglet's body mass.

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