STUDIES ON THE ALIMENTARY FLORA OF PIGS

IV. THE ALIMENTARY FLORA OF PIGS INFECTED WITH HOG CHOLERA

Manabu OGATA and Yoshiyuki MORISHITA

Department of Veterinary Microbiology, Faculty of Agriculture, University of Tokyo, Tokyo

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In their previous papers, the authors have reported their studies on the development of the fecal flora after birth and the influences of orally administered antibiotics and fermented-chlorella diet on the fecal flora. Since Moukhine mentioned the abnormality of the intestinal flora of pigs with diarrhea, an abnormal bacterial flora has been reported hitherto by Namioka et al., Tada and Hurst, Chopra et al., Kenworthy et al., Smith and Jones, Meszaros and Pestie, Palmer and Holland, and Pestie. According to these investigations, the bacterial flora of the alimentary tract is disturbed under such conditions as early-weaning diarrhea, bacterial or viral infection, arrival-diarrhea, and common diarrhea. However, no mechanisms of the disturbance of the bacterial flora have been explained as yet. The experiments reported herein were undertaken to extend the observations of Smith and Jones. Their aims were to determine how each microorganism was situated in each region of the alimentary tract of the pig during the pathophysiological process of hog cholera infection and to obtain any suggestion about the importance of the normal flora by studying the abnormal flora.

MATERIALS AND METHODS

1. Experimental materials

In the four experiments shown on Table 1, bacterial counting was made on the contents of the stomach, the anterior jejunum (approximately 1.0–1.5 m below the pylorus), the ileum, the cecum, the colon (middle portion), and the rectum.

Experiment 1: Four healthy pigs were used as controls.
Experiment 2: Five pigs were examined on the fifth day after injection with the ALD strain of hog cholera virus.
Experiment 3: Three pigs were killed on the first, the second, and the fifth day, respectively, after injection with the same virus as mentioned above.
Experiment 4: Three pigs were killed 4 months after they were challenged with the above-mentioned virus 3 weeks following immunization with hog cholera inactivated vaccine. They developed such symptoms as fever and poor appetite about 3 days after the injection of the virus. They recovered to normal within a few days and remained apparently healthy.

2. Enumeration of microorganisms

The media and cultural methods used were the same as reported previously by Mitsuoka et al. Two kinds of non-selective media and nine kinds of selective media were used for enumerating the eleven types of aerobic or anaerobic microbes.

### Table 1. Details of Animals Examined

<table>
<thead>
<tr>
<th>Experimental No.</th>
<th>Breed of pig</th>
<th>Body weight [kg]</th>
<th>No. of Pigs</th>
<th>Dose of virus (MLD)</th>
<th>Route of injection</th>
<th>Interval between virus injection and slaughter [days]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Y, LY</td>
<td>50～70</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>75</td>
<td>5</td>
<td>10⁵～10⁶</td>
<td>SC²</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Y</td>
<td>50</td>
<td>3</td>
<td>10⁴</td>
<td>SC</td>
<td>1, 2, 5</td>
</tr>
<tr>
<td>4)</td>
<td>Y</td>
<td>80</td>
<td>3</td>
<td>10⁴</td>
<td>SC</td>
<td>120</td>
</tr>
</tbody>
</table>

1) Y: Yorkshire, LY: Landrace×Yorkshire.
2) SC: Subcutaneous injection at the neck.
3) Immunized with inactivated hog cholera vaccine three weeks before injection of hog cholera virus.

3. Value of pH of the contents of the stomach

In experiments 1 and 2 with pigs, pH values of the stomach contents were determined approximately with pH test paper.

### RESULTS

Experiment 1: Bacterial flora of the alimentary tract in healthy pigs

Fig. 1 illustrates the distributions, as clarified by median counts, of various bacteria in the alimentary tracts of 4 healthy adult pigs.

Lactobacilli were most predominant throughout the alimentary tract. The median counts of lactobacilli in the stomach, the anterior jejunum, and the posterior portion of the intestine between the ileum and the rectum, inclusive (the posterior intestine), were 8.0, 7.3, and 8.4～9.4, respectively.

Bifidobacteria were present in considerable numbers in the whole alimentary tract. The median counts of them were 6.3, 5.6, and 7.5～8.5 for the stomach, the anterior jejunum, and the posterior intestine, respectively.

In contrast, it was found that such microorganisms as streptococci, enterobacteria (*Escherichia coli*), bacteroïdes, anaerobic streptococci, and veillonellae were present in small numbers or absent in the stomach and the anterior jejunum, and that they were present in much larger numbers in the posterior intestine than in the upper parts (the stomach and the anterior jejunum).

Streptococci and *E. coli* in the upper parts were 0～3.1 and 0～4.6, respectively, in median count and those in the lower parts, or the posterior intestine, 5.3～8.5 and 6.3～7.2, respectively.

Bacteroides were confined to the large intestine, where they were present in large numbers (6.1～8.2).

Anaerobic streptococci (principally *Peptostreptococcus elsdenii*) were usually found in large numbers (5.8～7.8) in the large intestine, but were uncommonly found in the upper parts of the alimentary tract.

Veillonellae showed essentially the same tendency as bacteroides, except that they were present in small numbers (4.1～6.1) in the large intestine.

Clostridia (lecithinase-positive), staphylococci, yeasts, and molds were uncommonly found in small numbers throughout the gut.

Experiment 2: Bacterial flora of the alimentary tract in pigs on the fifth day after injection with the ALD strain of hog cholera virus

All the pigs examined were in critical condition. Fig. 2 illustrates the results of median counting of various bacteria. In Fig. 3, a pig suffering from hog cholera was
compared with a healthy pig in respect to enterobacteria, bacteroides, and lactobacilli in the whole alimentary tract.

The bacterial flora of the alimentary tract of the pig suffering from hog cholera was quite different from that of the healthy pig. Enterobacteria were predominant throughout the alimentary tract in the diseased pig, and lactobacilli in the healthy pig. The median counts of enterobacteria in the stomach to the rectum ranged from 8.1 to 9.2 in the former pig and were very much lower in the latter. The enterobacterial flora

**Fig. 1. Alimentary Flora of 4 Healthy Pigs**

**Fig. 2. Alimentary Flora of 5 Pigs on the Fifth Day after Injection of Hog Cholera virus**
consisted principally of *E. coli*, klebsiellae, aerobacters, and citrobacters. The numbers of bacteroides present in various regions of the alimentary tract were 7.2, 7.5, 8.3, 8.1, and 8.5, respectively in the diseased pig, while they were very much smaller in the healthy pig.

In the diseased pig, streptococci and veillonellae were present in considerably larger numbers in the upper parts of the gut than in the healthy pig, and lecithinase-positive clostridia increased progressively in number from the stomach to the rectum; this tendency was not found in the healthy pig.

In contrast, lactobacilli in the gut were found much smaller in number in the diseased pig than in the healthy pig. The median counts of them in the stomach, the anterior jejunum, the ileum, the cecum, and the colon or the rectum were 5.8, 5.9, 6.9, 7.8, and 7.1, respectively, in the former pig.

**Fig. 3.** Comparative Distribution of Enterobacteria, Bacteroides, Lactobacilli in the Alimentary Tract of Healthy Pig and Hog Cholera-Infected Pig

Upper level: Healthy pig. Lower level: Hog cholera-infected pig.

**Fig. 4.** Alimentary Flora of a Pig on the First Day after Injection of Hog Cholera Virus

- \( \triangle \) Lactobacilli
- \( \triangle \) Bifidobacteria
- \( \bullet \) Aerobic streptococci
- \( \square \) Bacteroides
- \( \circ \) Enterobacteria
- \( \square \) Anaerobic streptococci
- \( \triangledown \) Veillonellae
- \( \bullet \) Yeasts
- \( \triangle \) Staphylococci
- \( \circ \) Molds
Bifidobacteria in the lower parts were a little smaller in number in the diseased than in the healthy pig. The median counts of them were 5.8~5.9 in the upper parts and 6.9~7.9 in the lower parts.

Anaerobic streptococci were uncommonly found in the 5 diseased pigs, except one in which they were present in large numbers.

Staphylococci were found in considerable numbers (6.8) in the stomach and anterior jejunum in a pig, but infrequently in the other pigs in only small numbers.

Yeasts were isolated frequently from the alimentary tract, where they were not numerous but in small numbers.

Molds were never found in any region of the alimentary tract in all the diseased pigs.
In addition to the above-mentioned bacteria, pseudomonas and unidentified Gram-negative bacilli were isolated in considerable numbers from some pigs.

Experiment 3: Bacterial flora of the alimentary tract of pigs on the first, second, and fifth day after injection of hog cholera virus

As presented in Figs. 4 and 5, the bacterial flora of the alimentary tract of pigs on the first and second day after injection of the virus was similar to that of healthy pigs, except that anaerobic streptococci and yeasts were found in numbers of 5.8 to 8.5 and 3.9 to 5.4, respectively, throughout the gut.

Lactobacilli were most predominant and bifidobacteria subordinated; streptococci, bacteroides, enterobacteria, and veillonellae were present in small numbers in the upper parts of the gut and were in large numbers in the lower parts.

On the fifth day, however, enterobacteria multiplied markedly in the whole alimentary tract, especially in the upper parts. Their number in region were 6.1, 7.6, 7.8, 8.1, and 8.6, respectively (Fig. 6). Streptococci were not found in so large numbers as encountered in experiment 2. Yeasts showed a distribution similar to that on the second day.

Experiment 4: Bacterial flora of the alimentary tract in vaccinated pigs 4 months after injection of hog cholera virus

Three pigs examined were immunized with inactivated hog cholera vaccine 3 weeks before injection of the virus.

As indicated in Fig. 7, the alimentary flora of the vaccinated pigs showed an intermediate pattern between those in experiments 1 and 2 on the whole.

In the portion from the stomach to the ileum, lactobacilli, streptococci, bifidobacteria, bacteroides, and enterobacteria ranged from 5.3 to 6.9 in median count; i.e., the counts of them in this portion were 6.3~6.9, 5.6~6.8, 5.3~6.4, 5.4~6.3, and 5.3~5.9, respectively. Anaerobic streptococci (5.3~5.4), staphylococci (4.9~5.1), and yeasts (4.3~4.8) were also found in such considerable numbers as indicated in parentheses in the stomach and the anterior jejunum, but they were present in small numbers in the ileum.

![Fig. 7. Alimentary Flora of 3 Vaccinated Pigs Four Months after Injection of Hog Cholera Virus](image-url)

Median counts are given in the diagram.

- ▲ ▲ Lactobacilli
- ▲ ▲ ▲ Bifidobacteria
- ● ● ● Aerobic streptococci
- □ □ □ Anaerobic streptococci
- □ □ □ □ Anaerobic streptococci
- △ △ Staphylococci
- ○ ○ Yeasts
- △ △ △ △ Staphylococci
- ✶ ✶ Molds
- ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●
Fig. 8. Numbers (Median and Range) of Different Kinds of Microorganisms in the Alimentary Tract of Pigs in Experiments 1, 2, and 4.

S: Stomach, Aj: Anterior jejunum, I: Ileum, C: Cecum, Cl or R: Colon or rectum

veillonellae, and clostridia were either present in very small numbers or absent.

In the cecum and the colon, lactobacilli, streptococci, and bacteroides constituted the first group; the median counts in these regions were 8.9–9.6 for lactobacilli, 9.1–9.4 for streptococci, and 8.9–9.0 for bacteroides. Bifidobacteria, enterobacteria, and anaerobic streptococci, which constituted the subordinate group, were found in large numbers of 7.6, 7.3–7.8, and 7.3–7.9, respectively, in the cecum and the colon. Veillonellae (4.0–4.8), yeasts (2.9–4.3), molds (2.3–3.4), and clostridia (0–3.1) were almost present in small numbers. In a pig, the numbers of clostridia were 6.8 in the ileum, 6.3 in the cecum, and 6.6 in the colon.

The results of the experiments mentioned above, except experiment 3, are illustrated and compared in Fig. 8.

DISCUSSION

The alimentary flora of a pig infected with hog cholera (exp. 2) was different from that of a healthy pig (exp. 1). Enterobacteria and bacteroides were present in much larger numbers and lactobacilli were in much smaller numbers in the infected pig than in the healthy pig. In addition, the other differences between the 2 experiments were the higher concentrations of streptococci and veillonellae in the upper parts and that of clostridia in the lower parts of the alimentary tract in the infected pig. Bifidobacteria showed a somewhat low level in the infection of hog cholera, but were relatively stable.

The abnormal flora in pigs infected with hog cholera, as evidenced in experiment 3, was developed not immediately after the injection of the virus, but soon after the onset of fever and anorexia; i.e., on or after the third day following the injection.

As indicated in experiment 4, the alimentary flora of a pig which had recovered from the mild infection of hog cholera by vaccination showed an intermediate type between those of the healthy and the infected pig. It was characteristic of streptococci
and bacteroides that increased in number throughout the alimentary tract. Enterobacteria, however, were found in moderate numbers only in the upper parts of the gut, but did not change in number in the lower parts. The numbers of lactobacilli in the stomach and small intestine were similar to those in the infected pig, but that in the large intestine was similar to that in the healthy pig. Staphylococci and yeasts were present in the upper parts. The results obtained from experiment 4 indicate that the flora was more remarkably abnormal in the stomach and small intestine than in the large intestine. The three examined pigs were all apparently healthy and developed no diarrhea. The contents of the small intestine, however, was rich in watery slime and partially digested particles. These results suggest that even apparently healthy pigs may have an abnormal bacterial flora and may be in abnormal conditions of digestibility and absorption in the digestive canal.

Several factors are mentioned below to explain how the abnormalities of the alimentary flora of the pig are associated with hog cholera infection.

Rise in pH value of the stomach contents—The pH values of the stomach contents of the pig infected with hog cholera were approximately 5.4 to 5.8. These values are similar to those reported by Smith and Jones, but are higher than those in the healthy pig. A rise in pH value is followed by the appearance of an abnormal bacterial flora in the stomach and then an abnormal intestinal flora.

Change in intestinal motility—It is well known that a pig infected with hog cholera shows a tendency to be constipated. For example, a pig in experiment 2 suffered from constipation. It was observed that the stomach contents of 2 pigs infected with hog cholera were bile-stained and that their small intestine had retained bile. These results suggest that a delayed or arrested peristaltic movement may occur in the small intestine in the process of infection, and that the retention of the chyme in the small intestine induced by poor peristalsis may be associated with the abnormalities of the intestinal flora. Dixon reported that inoculated bacteria were removed rapidly from the small intestine by its peristaltic action. Pesti mentioned that the oral administration of croton oil and tincture of opium resulted in a great increase in E. coli in the intestine of the pig. Miller and Bohnhoff demonstrated that when the subcutaneous administration of morphine interrupted peristalsis early enough to detain the inoculum in the small intestine, multiplication of Salmonella enteritidis occurred and infection resulted. These reports lend support to a view that the unusual movement of the small intestine permits the development of an abnormal flora in the organ.

Hypofunction or abnormal function of various organs—The infection of hog cholera virus will be followed by depression or change in function of various organs and by lowering of physical strength. With physical strength lowered, the mucosa, particularly the one attacked by the virus, of the digestive tract will be suitable for bacterial proliferation. Smith and Jones isolated a great number of bacteroides from the necrotic tissue of the intestinal wall.

Nutritional inadequacy of the chyme of the alimentary tract—Pigs began to show fever and anorexia about 3 days after the injection of the virus. Anorexia resulted in poor intake of dietetic nutrients. Therefore, the growth of fastidious lactobacilli might be depressed to a certain extent. In contrast, the other bacteria with low demands for nutrients might not be disturbed to proliferate. It might be justified that enterobacteria and bacteroides, which have a high tolerance against the bile-substances, had proliferated distinctly in the infected pigs. It was in pigs deprived of food for 1 to 3 days that lactocilli and bifidobacteria decreased very markedly in the stomach and the small intestine and that enterobacteria and bacteroides increased considerably in the ileum (unpublished data). A great reduction in number of lactobacilli and bifidobacteremia was
found in the stomach and the anterior jejunum after fasting for 1 day, and in a portion
from the stomach to the ileum after fasting for 3 days. Such a remarkable reduction
in lactobacilli and bifidobacteria, however, was not observed in an anorectic pig infected
with hog cholera. Apparently healthy pigs which had withstood a challenge with the
virus on account of acquired immunity and which had normal appetite were evidenced
to have an abnormal flora and a plenty of watery chyme containing many dispeptic food
particles in the small intestine. On the basis of these findings, it is speculated that the
abnormal alimentary flora may also be related to such nutritional changes of the contents
of the digestive canal as induced by a supply of nutrition from constituents derived from
bacteria and the mucosa and indigested food, and possibly to changes in moisture and
concentrations of salts in the digestive canal[10], particularly in the small intestine.

Immunological abnormality—In their study of patients suffering from hypogamma-
globulinemia or a-γA-globulinemia and intestinal disorders, CRABBé and HEREMANS found
that the intestinal mucosa was strikingly poor in cells containing γA-immunoglobulin.
They suggested some important function of a normal immunological pattern of the
gastrointestinal mucosa in the physiology of the stomach and intestine. This suggestion
should be taken into consideration to understand a relationship between the abnormal
flora and disorders of the gut, though it is not necessary for this to be emphasized in
hog cholera infection.

Interbacterial relationship—As an interbacterial balance depends upon such environ-
ment factors as the chyme and the mucosa of the gut, alterations in the environment
result in changes in the constitution of the bacterial flora. A variety of affinities of
bacteria for the mucosa may be manifested as an interbacterial antagonism, and may be
reflected upon the bacterial flora of the contents of the alimentary tract. For example,
in pigs infected with hog cholera, enterobacteria and bacteroides may multiply pro-
speroously in the mucosa, as well as in the contents of the gut, in the pathophysiological
process and may occupy much space for proliferation. In contrast, lactobacilli in the
mucosa, which are in large numbers in healthy pigs (unpublished data), may be over-
powered by the two types of bacteria mentioned above and may occupy less space
when the mucosa is in the state of undernourishment on account of the disease. Probably,
enterobacteria and bacteroides first show an extreme proliferation in the infected pig,
giving rise further to an abnormal flora. It is of great interest to note an excessive
increase in bacteroides in the abnormal flora of the pig infected hog cholera. Further
studies are necessary to clarify the significance of bacteroides in the infected pig.

In summarizing the results mentioned above, it is supposed that the formation of
an abnormal alimentary flora may be brought about by such alteration in interbacterial
equilibrium as induced by complicated factors, including a high pH value of the stomach
contents, abnormal movement of the gut, hypofunction of some organs, lowered resistance
of the mucosa against bacterial multiplication, and changes or undernourishment of
nutritional constituents of the contents of the digestive canal.

The abnormal flora of the alimentary tract of a pig infected with hog cholera shows
a tendency similar to that of a pig dying from Salmonella choleraeuis infection and
studied by SMITH and JONES[21], but is distinct from that of a pig suffering from E. coli
infection or edematous disease and reported by SMITH and JONES[19]. There are two types
in the abnormal alimentary flora of pigs. One is found in the intestine, but not in the
stomach, and the other both in the stomach and in the intestine. The pH value of the
stomach contents is normal in the former, but is higher than normal in the latter. It is
clear that there is a difference in mechanism for development between the two types of
abnormal flora. The abnormal alimentary flora developd as a consequence of hog cholera
infection in pigs may conversely have an additional undesirable effect on the physiology
of the animal body, especially on the physiology of digestion and absorption in the gut. According to Mészáros and Pestö, the functional disorder of the pancreas in the different forms of gastroenteritis results in a decrease of occasionally a complete disappearance of the tripsin, lipase, and amylase activity of the intestine in pigs. Kenworthy et al. asserted that in newly weaned piglets the hemolytic E. coli organism acted as an exacerbating agent, rather than as a primary pathogen. From the results of experiment 4, it is deduced that when an immunized pig is naturally infected with hog cholera on a farm, an abnormal flora is produced in the digestive canal of the animal and persists for a long period. This deduction will be verified by further studies.

SUMMARY

Bacteriological examination was made on the contents of various levels of the alimentary tract in healthy pigs, as well as in unvaccinated and vaccinated pigs infected with hog cholera virus.

1. In the healthy pig, lactobacilli were the most predominant of all the species examined throughout the alimentary tract. The number of bifidobacteria was approximately one-tenth to one-hundredth of that of lactobacilli. Streptococci, E. coli, and anaerobic streptococci increased progressively in number from the stomach to the large intestine. Bacteroides and veillonellae were usually confined to the large intestine.

2. In unvaccinated pigs killed on the fifth day after injection with hog cholera virus, enterobacteria and bacteroides showed a violent increase to be predominant at all the levels of the alimentary tract. These results were quite different from those of the healthy pig. Streptococci and veillonellae increased markedly in number in the upper parts (the stomach and the anterior jejunum) and clostridia (lecithinase-positive) in the lower parts. In contrast, lactobacilli were reduced markedly in number throughout the alimentary tract, as compared with those in the healthy pig. Bifidobacteria were rather stable, although they decreased only slightly in the lower parts. The enterobacteria detected consisted principally of E. coli, klebsiellae, aerobacters, and citrobacters.

3. The alimentary flora of pigs on the first and second day after injection of hog cholera virus had the same pattern as that of the healthy pig. On the fifth day, however, enterobacteria increased strikingly in number, especially in the upper parts.

4. In vaccinated pigs examined four months after injection of the virus, streptococci, bacteroides, and enterobacteria in the upper parts increased considerably in number as compared with those in the healthy pig, while lactobacilli were fairly reduced in number. In the lower parts, streptococci and bacteroides constituted a predominant group, together with lactobacilli, but the other members of the flora showed a distribution similar to that of the healthy pig. Those pigs were apparently healthy, but in them the contents of the upper part of the small intestine were watery and contained many undigested food-particles.

5. Several factors concerning the abnormalities of the flora of the gastrointestinal tract were discussed.

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豚の消化管内細菌叢に関する研究

IV. 豚コレラウイルス接種豚における消化管内細菌叢

尾形学・森下芳行
東大農学部家畜微生物学教室
（昭和43年10月25日受付）

豚腸内および豚コレラウイルス接種豚の消化管各部位（胃、上部空腸、回腸、盲腸、結腸、直腸）の内容物について、その細菌叢の検査を行ない、次のような結論を得た。

1. 健康豚では、Lactobacillus が消化管全体において最優先であった。Bifidobacterium は、Lactobacillus の 1/10〜1/100 程度に検出された。Streptococcus, Bacteroides, Escherichia coli, 嫌気性 Streptococcus および Veillonella は、消化管上部で少なく、下部で多く、その他の菌種は非常に少ない。

2. 豚コレラウイルス接種後5日目の豚では、Enterobacteriaceae 及び Bacteroides の消化管全体における激増、Streptococcus 及び Veillonella の消化管上部での著増、ならびに Clostridium の下部での著増が認められた。一方、Lactobacillus は全消化管において著減を示した。Bifidobacterium は下部で、多少減少を示したが、比較的安定していた。Enterobacteriaceae の構成菌種として、E. coli のほか、Klebsiella, Acrobacter および Citrobacter もかなり検出された。

3. 豚コレラウイルス接種後1日目および2日目の豚では、その細菌叢は、健康豚と同様の傾向を示した。しかしながら、5日目では、Enterobacteriaceae に激増が認められた。

4. 豚コレラ不活化ワクチンの接種後、3週間置いて、ウイルスを接種し、その後約4月を経過した豚では、消化管上部で Streptococcus, Bacteroides および Enterobacteriaceae の著増、ならびに Lactobacillus の著減が認められた。下部では、Streptococcus 及び Bacteroides の増加がみられたが、他の菌種は、健康の場合と同様の傾向を示した。全体としては、豚の細菌叢は、健康豚と豚コレラ感染豚のそれらの中間型をなした。

5. 消化管内異常細菌叢の形成に関与する要因について考案した。