**Title:** ORAL TREATMENT OF HELICOBACTER INFECTION

**Abstract**

Method of eliciting in a mammalian host a protective immune response to *Helicobacter* infection, by orally administering to the host an immunogenically effective amount of *Helicobacter* antigen. Vaccine compositions are also provided.
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ORAL TREATMENT OF HELICOBACTER INFECTION

The present invention relates to the treatment of gastric infection in mammals, including humans. More particularly, the present invention relates to a method for the treatment of Helicobacter infection in mammals, including humans, and to vaccine compositions and antibodies suitable for use in such treatment.

BACKGROUND OF THE INVENTION

Helicobacter pylori (H. pylori) infection of human gastric epithelium is a major factor in the development of gastritis and ulcers and may be a risk factor for the development of gastric cancer\textsuperscript{1-3}. This slender S-shaped gram negative microorganism is routinely recovered from gastric tissue of adults and children with histologic evidence of gastritis or peptic ulceration. Evidence for a causal relationship between H. pylori and gastroduodenal disease comes from studies in human volunteers, gnotobiotic pigs, and germ-free rodents whereby postulates by Koch were satisfied by creating histologically confirmed gastritis following consumption of viable microorganisms\textsuperscript{4-11}. Although difficult to treat, when eradication is achieved the underlying gastritis resolves and, in patients with duodenal ulcer disease, the recurrence rate of the ulcer decreases dramatically\textsuperscript{12}.

In spite of in vitro susceptibility to many antimicrobial agents, in vivo long-term eradication of established H. pylori infections with
antimicrobial agents is difficult to achieve. The microorganism is found within the mucous coat overlying the gastric epithelium. This is a location which does not appear to allow for adequate antimicrobial levels to be achieved when given orally. At the present time, most authorities recommend a "triple therapy", namely a bismuth salt in combination with tetracycline and metronidazole for 2-4 weeks. However, the effectiveness of this or other chemotherapeutic regimens remains suboptimal.

At the present time little is known regarding the role of the mucosal immune system in the stomach. The distribution of Ig producing cells in the normal gastric antrum indicates that IgA plasma cells make up 80% of the total plasma cell population. In addition, the number of plasma IgA cells present in the gastric antrum is comparable to other mucous membranes. Although a number of studies have looked at immunoglobulin levels in various endocrine fluids, no data is available regarding the concentration of immunoglobulins in gastric secretions. Moreover there is only limited data to suggest that patients infected with _H. pylori_ develop specific IgG and/or IgA antibodies in gastric aspirates. Thus, once infection is established, neither antibody nor antibiotics are very effective at eradication.

Czinn et al have shown that repetitive oral immunizations with _H. pylori_ antigens and cholera toxin result in the inducement of a vigorous gastrointestinal IgA anti- _H. pylori_ response in mice and ferrets. However, since mice and ferrets are resistant to _H. pylori_ infection and since no
small animal model existed at that time to evaluate protection, it was unknown whether the antibodies so formed were protective.

Lee et al have reported the ability to infect germ-free rodents with H. felis and reproducibly document histologic gastritis$^{9,10}$. However, no evaluation of protection has been reported.

There remains a need therefore for an effective treatment of H. pylori gastric infection, especially in humans. The present invention seeks to fill that need.

**SUMMARY OF THE INVENTION**

The present inventors have discovered, surprisingly, that oral immunization of a host with *Helicobacter* antigen results in the formation of antibodies which are protective against acute infection by *Helicobacter* microorganisms. The formation of such protective antibodies was not predictable on the basis of prior work since, prior to the present invention, no suitable model existed to evaluate protection.

According to one aspect of the present invention, there is provided a method of eliciting in a mammalian host a protective immune response to *Helicobacter* infection, comprising orally administering to the host an immunogenically effective amount of *Helicobacter* antigen to elicit the desired protective immune response.

According to another aspect of the present invention, there is provided a vaccine composition comprising an amount of *Helicobacter* antigen
effective to elicit a protective human response in a patient, in association with a pharmaceutically acceptable diluent.

According to a further aspect of the present invention, there is provided a method of imparting to a mammalian host passive protection to *Helicobacter* infection, comprising orally administering to the host a immunologically effective amount of a *Helicobacter* specific IgA antibody to impart the desired passive protection.

According to yet another aspect of the present invention, there is provided a murine *H. felis* specific IgA or IgG monoclonal antibody.

According to a yet further aspect of the invention, there is provided a cell line #71-G5-A8.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will now be further described with reference to the accompanying figures, in which:

Figure 1 is a bar chart of antibody titers in various sera and secretions of germ free mice after oral immunization with *H. felis* lysate in association with cholera toxin; and

Figures 2A and 2B are bar charts of percent of mice infected with *H. felis* after active immunization (Figure 2A) and passive immunization (2B) compared with controls.

**DETAILED DESCRIPTION OF THE INVENTION**

The present inventors have demonstrated that oral
immunization in mice using *H. felis* antigen produces a protective immune response wherein antigen specific protective antibodies are present in gastric secretions. The effect of the protective immune response is that immunized animals when challenged with pathogen do not become infected in comparison to non-immunized animals which do become infected. While not being bound by any theory, the present inventors believe that oral immunization with the *H. felis* antigen stimulates the common mucosal immune system and perhaps local sites in the gastric mucosa resulting in the appearance of *H. felis* specific IgA antibodies in the gastric secretions, which prevent *H. felis* infection. Since *H. felis* and *H. pylori* are similar species from the same genus (*Helicobacter*), it is reasonable to conclude that immunization of for example a germ-free pig with *H. pylori* antigen plus a mucosal adjuvant such as cholera toxin will be effective in preventing *H. pylori* infection of the stomach. Since it is a routine matter to conduct pre-clinical trials of candidate vaccines for human use in animal models, it is believed that the methodology of the present invention is effective in humans, especially in the treatment of *H. pylori* infection in humans.

It has been discovered by the present inventors that an *H. felis* germ-free mouse model can be employed to evaluate antibody protection levels following immunization with *H. felis* antigen. Figure 1 relates to the results obtained in experiments with the *H. felis* germ-free mouse model. Oral immunization of the model with bacterial antigens in association with cholera toxin resulted
in elevated serum, gastric and intestinal anti- \textit{H. felis} antibody titers and protection from acute infection of the stomach by \textit{H. felis} pathogen. In the experiments, groups of Swiss-Webster germ-free mice (Taconic) were orally immunized 4 or 5 times over a one month period with 2-4 mg of sonicated \textit{H. felis} lysate plus 10 \( \mu \)g of cholera toxin. The mice were then challenged orally with approximately \( 10^6 \) viable \textit{H. felis} bacteria. The mice were sacrificed and intestinal and gastric secretions collected as described in the following working Examples. Anti-\textit{H. felis} antibody titers were determined by ELISA. The black solid bars in Figure 1 represent mean titers (± S.D.) from immunized mice and the open bars represent mean titers (± S.D.) from the control non-immunized mice. The results presented graphically in Figure 1 are summarized in Table 1 below.

\textbf{TABLE 1}

\begin{center}
\begin{tabular}{ccc|ccc|cc}
 & & & Serum & Gastric & & Intestine \\
 & IgA & IgG & IgA & IgG & & IgA & IgG \\
\hline
CONTROL & 3.1 & 3 & 0 & 0 & & 1.6 & 1.1 \\
IMMUNIZED & 11.8 & 16.8 & 2.1 & 4.25 & & 4.5 & 4.4 \\
\end{tabular}
\end{center}

\begin{center}
\textbf{H. FELIS INFECTION} \hspace{2cm} \textbf{PROTECTION}
\end{center}

\begin{center}
\begin{tabular}{lll}
H. felis (+) & H. felis (-) & \\
Control n=18 & 14 & 4 & 23% \\
Immunized n=17 & 4 & 13 & 78% \\
\end{tabular}
\end{center}

\textbf{SUBSTITUTE SHEET}
It can be seen from the above results that significantly higher antibody titers are observed for the immunized mice than for the control animals.

Figures 2A and 2B depict the results of studies to establish the protection against infection by *H. felis* by conducting active and passive immunization experiments. Referring to the active immunization experiments, gastric biopsies were collected at sacrifice from the *H. felis* challenged mice in the experiments described above in connection with Figure 1. The biopsies were scored for the presence of *H. felis* by rapid urease test and/or culture positivity, described in the following working Examples. Figure 2A shows the results of pooled data from 3 experiments (n = 17 immunized animals and 18 control animals). The black (solid) bars represent challenged immunized mice and the striped bars the control non-immunized mice.

It will be seen that from a total of 17 immunized animals, only 4 became infected, as compared to 14 of the 18 control animals. In other words, 78% percent of the immunized animals were protected from *H. felis* infection as compared to 23% of the non-immunized animals.

The fact that protection was the direct result of IgA antibodies was established by passive immunization of germ-free mice with *H. felis* specific IgA monoclonal antibodies and comparison of the resulting protection with that exhibited by mice given no antibody or irrelevant antibody (for example Sendai virus specific IgA monoclonal antibody). The results are set forth in Figure 2B.

An IgA monoclonal antibody reactive with *H. felis*...
* felis was isolated and subcloned after an immunization protocol similar to that described in Figure 1. Ascites containing *H. felis* specific IgA monoclonal antibody produced from the cell line #71-G5-A8, prepared as described in the working Examples, or Sendai virus specific IgA monoclonal antibody or saline were orally administered to germ-free mice at the time of infection with *H. felis*, and 4, 8, and 24 hours later. Seven days after infection, the mice were sacrificed and gastric biopsies scored for *H. felis* (n = 7 mice received *H. felis* specific monoclonal antibody and 13 mice received no antibody or Sendai virus specific monoclonal antibody). The black solid bars represent the mice which received the *H. felis* specific monoclonal antibody and the striped bars represent the mice which received either Sendai virus specific monoclonal antibody or saline (no antibody).

These results establish that IgA alone protects against *H. felis* infection of the gastric mucosa.

It is also observed that oral administration of *H. felis* antigen results in significantly increased levels of anti-*H. felis* IgG antibodies as well as IgA antibodies. There are a number of possible explanations for this phenomenon. First, it has been observed that cholera toxin can, in some cases, enhance both antigen-specific IgA and IgG responses\(^{22}\). Secondly, cell traffic studies have shown that mesenteric node IgG lymphocytes are a component of the mucosal immune system and can give rise to mucosal IgG plasma cells which have been observed in gastric mucosa. Thirdly, at least a portion of the observed gastric IgG could be the
result of transudation of serum antibody into the gastric lumen secondary to mild to moderate inflammation observed in both control and immunized animals.

The above discussion has focussed on the use of H. felis antigen in the treatment of H. felis infection. It will be appreciated however that the present invention is not limited to the treatment of H. felis infection.

Thus, the present invention also includes within its scope the treatment or prophylaxis of mammals, including humans, for H. pylori infection, wherein the patient is orally immunized with an immunologically effective amount of H. pylori antigen in order to elicit the formation of protective antibodies to H. pylori pathogen. Preferably, the H. pylori is administered in association with a mucosal adjuvant, for example cholera toxin.

Moreover, the present invention includes within its scope the passive immunization of mammals, including humans, against H. pylori infection. This is achieved by orally administering an effective amount of an H. pylori specific antibody to the patient. Preferably an H. pylori specific IgA monoclonal antibody is orally administered to the patient.

The vaccine of the invention is administered orally in amounts readily determined by persons of ordinary skill in this art. Thus, for adults, a suitable dosage would be in the range of 10µg to 10 mg, for example 50µg to 5 mg. Similar dosage ranges would be applicable for children.
As noted above, a suitable mucosal adjuvant is cholera toxin. Others which may be used are non-toxic derivatives of cholera toxin, including its B subunit and/or conjugates of antigen plus cholera toxin or its B subunit, microcapsules, or immune stimulating complexes (ISCOM’s) or liposomes and attenuated live vectors such as viruses or Salmonella bacteria. The amount of mucosal adjuvant employed depends on the type of mucosal adjuvant used. For example, when the mucosal adjuvant is cholera toxin, it is suitably used in an amount of 5µg to 50µg, for example 10µg to 35µg. When used in the form of microcapsules, the amount used will depend on the amount employed in the matrix of the microcapsule to achieve the desired dosage. This is something within the skill of a person of ordinary skill in this art.

Suitable carriers and diluents are enteric coated capsules and/or 0.2N NaHCO₃ and/or saline.

**EXAMPLES**

The invention will now be further described by the following non-limiting examples.

**(a) The Mice**

The mice used in the experiments were germ-free Swiss Webster mice (8 weeks old) were obtained from Taconic (Germantown, N.Y.). The animals were housed in microisolator cages under germ-free conditions and they were allowed free access to autoclaved laboratory chows and water. With the exception of occasionally isolating diphtheroids, animals were maintained in a germ-free state throughout the immunization protocol.
(b) Bacterial Strains

Bacteria recovered from gastric biopsy specimens of a cat were identified as *H. felis* based on morphology, Gram stain, and the production of urease, catalase and oxidase. Organisms were stored in 50% phosphate-buffered saline (PBS). 25% glycerol: 25% heated fetal calf serum at -70°C. Bacteria used in the following examples were passaged in vitro two to three times after isolation.

(c) Bacterial Antigens

The test strain was inoculated onto Columbia agar (Difco, Detroit, MI) containing 7% horse blood and incubated microaerophilically at 37°C for 5-7 days. The organisms were harvested in PBS and the resulting suspensions were sonicated to lyse the bacteria at 40°C, cleared of cellular debris by low-speed centrifugation, and sterile filtered. These whole-cell sonicates were stored as 100μl aliquots at -70°C until needed for oral immunization of animals.

(d) Outer membranes

Outer membranes were prepared as described. Briefly, bacterial suspensions were treated with 1 mg of ribonuclease and deoxyribonuclease (Sigma Chemical, St. Louis) in 0.5 M Tris-EDTA buffer (pH 7.8) at 4°C immediately prior to sonication and low-speed centrifugation as above. Bacterial envelopes were then separated from the cleared lysate by ultracentrifugation at 150,000 x g for 1 h. Outer membranes were separated from the cell envelopes by differential solubilization in sodium n-lauroylsarcosine and recovered by ultracentrifugation. The resulting pellets were
suspended in 0.05 M phosphate buffer (pH 7.0),
divided into aliquots, and stored at -70°C. Protein
concentration was determined by the method of Lowry
et al for use in ELISA\textsuperscript{20}.

**EXAMPLE 1**

Mice were lightly anesthetized by i.p. injection
of 1.0 mg ketamine prior to intragastric
immunization. Then, whole cell sonicate preparations
plus 10 μg of cholera toxin (List Biologicals,
Campbell, CA) were suspended in 0.2 M NaHCO\textsubscript{3}, and
0.5 ml was delivered to the stomachs of mice by
intubation through polyethylene tubing attached to a
hypodermic syringe. This procedure will be referred
to as oral immunization.

To examine the possibility of developing
functional immunity, three oral immunization
protocols were evaluated. Protocol 1 consisted of 4
oral immunizations over 1 month consisting of 2 mg
*H. felis* lysate plus cholera toxin (a known mucosal
adjuvant). Protocol 2 increased the *H. felis* to 4
mg per immunization plus cholera toxin, and protocol
3 consisted of 5 oral immunizations over 6 weeks each
containing 4 mg of *H. felis* lysate plus cholera
toxin. Unless otherwise noted, animals were
challenged 7-10 days after the last immunization and
sacrificed 3-7 days later.

The following tissue fluids were collected:
serum, gastric secretions, and intestinal secretions.
These samples were then titrated for the presence of
anti-*H. pylori* antibodies by enzyme-linked
immunosorbent assay (ELISA). In addition, gastric
biopsies were obtained for rapid urease test and
culture. Infection was defined as positive if either
culture or rapid urease test (see below) was positive. Serum was obtained by tail vein bleeding and letting the blood clot at room temperature. Gastric and intestinal secretions were collected by a modification of the procedure of Elson et al.\textsuperscript{21,22}. Briefly, gastric and intestinal secretions from mice were collected separately. Stomachs and intestines were removed and injected with 2.0 ml of a polyethylene glycol-based lavage plus anti-protease solution. The gastric lavage contained Tris buffer to neutralize gastric acid.

The ELISA was carried out as follows. Murine samples were assayed for \textit{H. feli}s antibodies as follows. Ninety-six well polystyrene microtiter plates were coated with 100 µl/well of appropriate outer membrane proteins (20 µg/ml) overnight at 4°C. Non-specific binding sites were blocked with 1% BSA in PBS for 90 minutes at room temperature and then the plates were washed with 0.1% BSA in PBS. Samples were tested in duplicate at dilutions ranging from neat to 1:512,000 and 100 µl of each dilution per well was added to the antigen-coated plates. Following incubation at room temperature for 90 minutes, the plates were washed three times with 0.1% BSA in PBS, and 100 µl of a 1:1000 dilution of goat anti-mouse IgA or IgG alkaline phosphatase conjugate (Zymed, San Francisco, CA) was added to each well for 90 minutes. After washing, the plates were developed with 100 µl per well of a 1 mg/ml solution of p-nitrophenyl phosphate in glycine buffer (pH 9.6) for 1 hour. The absorbance at 410 nm was measured in each well using a Dynatech MR 700 Microtiter Plate Reader. The antibody titer was defined as the
reciprocal of the highest dilution yielding an 
optical density of 0.05 above wells which contained 
antigen and which were incubated with the antibody 
conjugate but without the primary antibody sample.18

The rapid urease test was carried out as 
follows. Two gastric biopsy specimens of 10 mg wet 
weight from each mouse were immediately placed in 0.2 
ml Stuart urease test broth28 and incubated at room 
temperature. The presence of urease was determined by 
color change from yellow to pink in the test broth 
after 4 hours24.

Cultures were obtained as follows. Gastric 
antral biopsies were homogenized and plated onto 
Columbia agar containing 5% sheep blood, and 
incubated at 37°C under microaerophilic conditions 
gas generating kit, Oxoid Ltd., London, UK. A 
positive culture was defined as visible growth after 
5 days. All isolates were identified as H. felis 
based on morphology, gram stain and the production of 
urease, catalase and oxidase.

Despite minor changes in experimental design 
among the three groups, no appreciable differences in 
immune response were noted. Thus, the data were 
pooled and the geometric means of gastric lavage, 
intestinal lavage, and serum antibody titers from the 
13 control and 12 immunized animals studied are set 
forth in Table 1 and Figure 1 discussed above.

Although these animals were both immunized and 
challenged, the antibody titers did not differ 
significantly from mice which were immunized and not 
challenged. In these experiments, gastric, intestinal 
and serum IgA and IgG antibody titers were 
significantly higher than that observed in the
unimmunized control animals. Specifically, there was a 4-fold increase in gastric IgA (p=.001), an 8-fold increase in intestinal IgA (p=.0038) and a 350-fold increase in serum IgA (p=.0001) compared with unimmunized control animals. Similarly, a significant elevation of gastric IgG (p=.0009), intestinal IgG (p=.0001), and serum IgG (p=.0001) was observed.

To evaluate protection from *H. helis* infection, gastric biopsies were taken from all animals at sacrifice and evaluated by both rapid urease test and culture, as described above. In addition, to determine whether control animals developed a chronic infection and whether immunized animals were definitely *H. helis* negative, additional immunized and control animals were challenged as above but were not sacrificed until 4 weeks after challenge. The rate of protection among all immunized groups of animals was not appreciably different.

In order to not exclude possible low-level infection, scoring of the gastric biopsy specimens as positive or negative for *H. helis* growth was not done until 5 days after plating. From plating serial dilutions of known numbers (by hemacytometer count) of culture grown *H. helis*, it was observed that the sensitivity of this endpoint is approximately 10 organisms. In later experiments, biopsy culture plates were sometimes kept even longer than 5 days and when plates which remained negative for visible growth were scraped and examined by wet mount, an isolated spiral shaped organism could occasionally be seen. The identity of these isolated organisms could not be confirmed, and it could not be determined if
they were viable. In any case, based on the culture results for serially diluted \textit{H. felis}, it is believed that biopsy specimens which remained negative for visible growth at 5 days contained 10 or fewer bacteria.

\textbf{EXAMPLE 2}

IgA and IgA monoclonal antibodies specific for \textit{H. felis} were produced by a modification of the procedure of Mazanec et al.\textsuperscript{15} BALB/c mice obtained from the Jackson Laboratory (Bar Harbor, Maine) were immunized intragastrically four times over a 6-week period, the first three times with 2 mg of sonicated \textit{H. felis} plus 10 \textmu g of cholera toxin (Sigma Chemical Co., St. Louis, MO). For the last immunization, cholera toxin was omitted, and the mice also received an intravenous boost with 2 mg of \textit{H. felis} protein. Three days later, the mice were sacrificed, and their spleen cells were hybridized to SP2/0 myeloma cells. Clones, obtained by limiting dilution, were screened for secretion of anti-\textit{H. felis} IgA antibody by an enzyme-linked immunosorbent assay (ELISA). The resulting cell line, identified as \#71-G\textsubscript{5}-A\textsubscript{B}, was found to be a stable IgA secreting hybridoma. After multiple subclonings, stable IgA and IgG secretors were injected intraperitoneally into pristane-primed BALB/c mice, and the ascitic fluid was harvested and clarified.

The cell line \#71-G\textsubscript{5}-A\textsubscript{B}, as of April 13, 1992, is deposited in and maintained in viable condition in the Laboratory of Steven J. Czinn, M.D., Rainbow Babies and Children's Hospital, Room 465, Case Western University, 2074 Abington Road, Cleveland, Ohio, U.S.A. 44106. Access to the deposit
will be available to a person determined by the U.S. Commissioner of Patents and Trademarks to be entitled thereto during pendency of the present application, and all restrictions on availability of the deposit to the public will be irrevocably removed upon grant of a patent on the application.

The cell line #71-G₅-A₈ is being deposited in the American Type Culture Collection, located at 12301 Parklawn Drive, Rockville, Maryland 20852, U.S.A., under the identification number #71-G₅-A₈. The ATCC accession number and deposit date are , respectively.

**EXAMPLE 3**

Passive immunization studies were carried out as follows. Ascites containing IgA monoclonal antibody produced from #71-G₅-A₈ (200µl) was administered intragastrically simultaneously with $10^6$ viable organisms. Preliminary studies indicated that gastric IgA titers of animals which received a single 200 µl dose of monoclonal IgA antibody declined to levels below that seen in actively immunized animals by 8 hours. Therefore, three additional doses of MAb were given over the next 24 hours. Control animals were challenged identically but received either saline or Sendai virus specific IgA monoclonal antibody (an irrelevant IgA monoclonal antibody). One week later, the mice were sacrificed. Gastric tissue was inoculated on Columbia blood agar plates and incubated for 5 days at 37°C. Infection was defined as a positive culture or a positive Stuart's rapid urease broth test.

To investigate whether IgA antibodies, the hallmark of the mucosal immune system, could by
themselves protect against *H. felis* infection of the gastric mucosa, *H. felis* IgA monoclonal antibodies were generated as described above. One of these antibodies (#71-G5-A8) was then passively orally administered to germ-free mice at the time of and after challenge with *H. felis*. Control animals received either saline or Sendai virus specific IgA monoclonal antibody specific for the hemagglutinin-neuraminidase glycoprotein of Sendai virus16.

The results are presented in Table 2.

**TABLE 2**

Evaluation of Passive Administration of Antibody To Germ-Free Mice Before and After Challenge with *H. felis*

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<th>Antibody Administered</th>
<th>Number of mice</th>
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<tr>
<td>None-Control</td>
<td>7</td>
<td>57%</td>
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<tr>
<td>Irrelevant IgA Monoclonal</td>
<td>6</td>
<td>83%</td>
</tr>
<tr>
<td>IgA anti-<em>H. felis</em> monoclonal</td>
<td>7</td>
<td>14%</td>
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*H. felis* or Sendai virus specific IgA monoclonal antibody were given intragastrically 4 times over 24 hours concurrent with challenge with $10^6$ viable *H. felis*. Gastric biopsies were obtained 1 week after challenge and infection was determined by culture and/or rapid urease test.

Of the 13 control animals receiving no antibody or Sendai virus antibody, 70% were infected (Figure...
2B). Of the seven experimental animals, six were protected and only 1 (14%) was infected. By Chi Square analysis, the difference was significant (p=.019).

Comparison of antibody titers among experimental groups was evaluated by analysis of variance and Fisher's protected T test. For protection, absence or presence of experimental infection among groups were evaluated by Chi Square analysis.
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WHAT IS CLAIMED IS:

1. A method of eliciting in a mammalian host a protective immune response to *Helicobacter* infection, comprising orally administering to the host an immunogenically effective amount of *Helicobacter* antigen to elicit said protective human response.

2. A method according to claim 1, wherein said *Helicobacter* antigen is *H. pylori* antigen.

3. A method according to claim 1, wherein said *Helicobacter* antigen is *H. felis* antigen.

4. A method according to claim 1, wherein said *Helicobacter* antigen is administered in association with a mucosal adjuvant.

5. A method according to claim 4, wherein said mucosal adjuvant is cholera toxin.

6. A method according to claim 1, wherein said mammalian host is human.

7. A vaccine composition suitable for the treatment of *Helicobacter* infection, comprising an immunogenically effective amount of *Helicobacter* antigen for eliciting a protective immune response in a mammalian host, in association with a pharmaceutically acceptable carrier or diluent.

8. A vaccine composition according to claim 7, and further comprising an effective amount of a mucosal adjuvant.

9. A vaccine composition according to claim 8, wherein said mucosal adjuvant is cholera toxin.
10. A vaccine according to claim 7, wherein said Helicobacter antigen is H. pylori antigen.

11. A vaccine according to claim 7, wherein said Helicobacter antigen is H. felis antigen.

12. A method of imparting to a mammalian host passive protection to Helicobacter infection, comprising orally administering to said host a immunologically effective amount of a Helicobacter specific IgA antibody to impart said passive protection to said host.

13. A method according to claim 12, wherein said antibody is a murine H. felis specific IgA antibody.

14. A method according to claim 13, wherein said antibody is a murine H. felis specific IgA monoclonal antibody produced by cell line #71-G5-A8.

15. A method according to claim 12, wherein said mammalian host is human.

16. A murine H. felis specific IgA monoclonal antibody.

17. A murine H. felis specific IgA monoclonal antibody.

18. The cell line #71-G5-A8.

19. A monoclonal antibody produced by cell line #71-G5-A8.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
   IPC(5) : A61K 39/02, 35/14; C07K 3/00, 13/00, 15/00, 17/00
   US CL. : 424/85.8; 530/388.2, 388.4
   According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
   Minimum documentation searched (classification system followed by classification symbols)
   U.S. : 424/85.8; 530/388.2, 388.4

   Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
   Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
   APS and Medline
   search terms: Helicobacter (pylori or felis)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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X Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search: 12 May 1993
Date of mailing of the international search report: 06 JUL 1993

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