Boila et al.\(^1\) have demonstrated the inhibitory effect of propionic acid added to a diet on the rat of cholesterol synthesis in the liver of swine. Some investigators have suggested that short-chain fatty acids (SCFAs) have metabolic effects that explain some of the physiologic responses attributed to dietary fiber (DF), because SCFAs are derived from the colonic bacterial fermentation of DF.\(^2\)\(^-\)\(^6\) We earlier reported that the addition of pectin to a diet increased the production of SCFAs in the cecum and decreased the cholesterol level in the liver of rats. In contrast, the addition of lard at a concentration of 12% (w/w) to the diet reduced the production of SCFAs and increased the cholesterol level in the liver compared with that at a concentration of 1% (w/w), and the concentration of acetic and propionic acids in the cecum of the rats was correlated negatively with the cholesterol level in the liver.\(^7\) The hypocholesterolemic effect of plant oils is well known.\(^8\)\(^-\)\(^12\) This effect may also relate to SCFAs produced in the colon, because we have obtained information that feeding corn oil increased the mass of colonic bacteria which produced SCFAs in rats. To determine whether plant oils would have a different effect from lard, an animal fat, on the production of SCFAs and on the cholesterol level in vivo, we examined the effects of corn oil and pectin as a plant oil and DF, respectively, on the production of SCFAs in the cecum, the growth of colonic bacteria, and the liver cholesterol level in rats.

Twenty 6-week-old male Sprague-Dawley rats (Japan Clea Inc., Tokyo) were used after being acclimatized to the laboratory conditions for 14 days. The diet for the acclimatizing period was composed of 5% corn oil, the other 95% of components being identical to the diet without pectin shown in Table I. After the acclimatizing period, they were divided into four groups and individually caged. The rats were then fed on the semi-purified diet shown in Table I for 2 weeks, food and water being provided ad libitum. The body weight and food intake were recorded every other day or every third day for all the rats. The other items shown in Tables II, III, and IV were measured according to the methods described in the previous report.\(^7\) The data were statistically analyzed by Duncan's multiple-range test or by a distribution-free multiple comparison test after Bartlett's test.

Table II shows the body weight gain, food intake, liver weight, cecum weight, and cholesterol and triglyceride levels. The body weight gain, food intake, and liver weight in the four dietary groups were similar to those in the previous experiment using lard.\(^7\) The cecum weight and the cecum + contents weight of the rats fed with 12% corn oil were no heavier than those of the rats fed with 1.5% corn oil, while in the previous experiment, the presence of 12% lard in the diet increased both the cecum weight and the cecum + contents weight. Liver cholesterol level was similar in all four dietary groups, whereas that in the previous experiment using 12% lard was increased. The triglyceride level in the liver of the rats fed with 1.5% corn oil and pectin was significantly higher than that of the rats fed with 12% corn oil without pectin, as was the case in our previous experiment using lard. However, this difference should not be attributed to an essential fatty acid (EFA) deficiency, different from the previous experiment, because as Table III shows, the triene/taetraene ratio in the rats fed with the 1.5% corn oil diet with and without pectin was 0.06 and 0.04, respectively, which is far less than the limit for normal EFA deficiency reported by Rivers and Frankel of 0.4.\(^3\)\(^,\)\(^13\) The plasma

### Table I. Composition of the Diets (%)

<table>
<thead>
<tr>
<th></th>
<th>Pectin</th>
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<tbody>
<tr>
<td></td>
<td>Corn oil</td>
<td></td>
<td>Corn oil</td>
</tr>
<tr>
<td></td>
<td>1.5%</td>
<td>12%</td>
<td>1.5%</td>
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<tr>
<td>Casein (milk)</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Corn oil</td>
<td>1.5</td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>Mineral mixture(^a)</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
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<tr>
<td>Vitamin mixture(^b)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vitamin E granules(^c)</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Choline chloride</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Pectin</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sucrose</td>
<td>68.8</td>
<td>58.3</td>
<td>65.8</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

\(^a\) AIN-76\(^TM\) mixture
\(^b\) This contained 500 mg of dl-a-tocopheryl acetate per gram.
\(^c\) Brown NF Unipectin produced by Sanohbio-Industries, the degree of esterification of this pectin being more than 65%.
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would
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production
of
SCFAs
by
colonic
bacteria
and
increase
the
cholesterol
level
in
the
liver.
The
effect
of
lipids
in
the
colon
may
be
the
opposite
to
that
of
DFs,
because
DFs
are
a
major
supplier
of
carbon
and
energy
to
colonic
bacteria.21
Although
the
effect
of
pectin
on
the
liver
cholesterol
level
was
different
from
that
in
the
previous
experiment
using
lard,
feeding
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decreased
the
plasma
cholesterol
level
similarly
to
that
of
the
previous
experiment.
This
shows
that
pectin
decrease
the
plasma
cholesterol
level
at
first,
but
not
the
liver
cholesterol
level,
when
the
rats
were
fed
with
a
diet
containing
pectin.
We
think
that
pectin
directly
attacked
lipids
in
the
digestive
tract,
and
therefore,
the
lipids,
particularly
cholesterol,
were
blocked
from
passing
through
the
wall
of
the
small
intestine.
Therefore,
pectin
should
initially
lower
the
plasma
cholesterol
level
in
rats.
We
think
that
the
effects
of
SCFAs
produced
by
colonic
bacteria
on
cholesterol
metabolism
would
be
more
mild
than
those
on
the
prevention
of
absorption
in
the
small
intestine,
because
the
plasma
cholesterol
level
was
significantly
lowered
by
feeding
pectin,
while
the
liver
cholesterol
level
was
not.
We
could
not
show
a
relationship
between
the
concentration
of
SCFAs
in
the
cecum
and
the
liver
cholesterol
level
in
this
study,
and
further
studies
are
needed
to
clarify
this.

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of
the
same
laboratory
for
the
statistical
analysis,
and
Mr.
Yoshiteru
Asai
and
his
coworker
of
the
Food
Research
Laboratory
at
Snow
Brand
Milk
Products
Co.,
Ltd.
for
their
analysis
of
SCFAs
with
a
carbonic
analyzer.

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