Hypercholesteremic effect of trepang (Stichopus japonicus) lipids

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Gipokholoesterinemichesko deistvie lipidov trepanga (STICHOPUS JAPONICUS)

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Nutrition
Hypercholesteremic effect of trepang (Stichopus japonicus) lipids
by
V.A. Shchepin and others

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Many researchers are interested in the prevention and cure of arteriosclerosis and hence experimental studies of the effect of substances that either reduce or intensify the arteriosclerotic condition are of considerable practical significance.

The arteriosclerotic condition is frequently preceded by disruptions in metabolism, including the metabolism of lipids. This process is usually accompanied by hypercholesteremia which by its nature may be exogenous or endogenous. The endogenous factor in the origin of hypercholesteremia has been experimentally demonstrated in a series of pathological cases [1], including periods of food deprivation [2]. The method is convenient in that food deprivation
facilitates the development of hypercholesteremia. That is why the starvation method may be used in a primary test of the hypercholesteremic effect of various substances.

Trepang, along with other foodstuffs of the sea, has been studied in the dietary therapy clinic of the Institute of Nutrition of the USSR Academy of Medical Sciences as a dietary item for patients suffering from arteriosclerosis. The positive effect of trepang has been established. Sea products are recommended for dietary therapy of patients suffering from arteriosclerosis [3]; however, we did not investigate the effect of the lipids of these products.

Our earlier research [4] indicated that trepang lipids are characterized by highly unsaturated fatty acids (67.7% of the detected acids are unsaturated and, of these, 38.14% are polyunsaturated). The main phospholipid constituent is lecithin [5].

Esters of cholesterol containing unsaturated fatty acids are more soluble, mobile and evacuate easier from the organism. On the other hand, the presence of lecithin, which has stabilizing properties [6–8], facilitates the retention of cholesterol in solution.

Recently there have been reports in the literature about the role of free radicals in lipid oxidation in the development of arteriosclerosis [9], along with a demonstration of the largest effect of antioxidant preparations. A study of the oxidation of lipids of a large number of marine organisms has shown that trepang lipids are more resistant to oxidation, which is due to the presence in them of antioxidants and their properties [10].
A high content of unsaturated fatty acids and lecithin-type phospholipids as well as the resistance of trepang lipids to oxidation, in our view, can facilitate normal lipid metabolism during hypercholesteremia.

The experiments were conducted on 37 unpedigreed rabbits of both sexes (average weight 3.4 kg; age 1.5--2 years). The hypercholesteremic condition in the animals was induced by the method of S.V. Nedzvetsky [2].

The rabbits were starved for a period of 6 days during which they received only water. On the 5th day the animals were divided into 3 groups. The first group, which consisted of 9 rabbits and constituted the control group, continued to be starved for another day, receiving only water. The second group, which included 19 rabbits, was administered perorally a water emulsion containing trepang lipids. We used Tween-80 as an emulsifier. The preparation was administered on the basis of 0.2 g per 1 kg of live animal weight. The lipids of the trepang from the Sea of Japan, which was described in previous papers [4, 5], were extracted according to the method of Bligh and Dyer [11]. The rabbits of the 3rd group (9) received perorally an equicaloric amount of egg albumin.

During the experiment we determined the amount of cholesterol in the blood plasma according to the method of Ilca [12], β-lipoproteins according to the method of Ledvina [13], and lipoid phosphor was determined by the method of Vas'kovsky and Kostetsky [14]. [Number 14 is not listed in the References, Tr.]. The phospholipids were determined on the basis of the phosphorus. The cholesterol/lecithin coefficient was calculated on the basis of the obtained data.
Влияние липидов трепанга на некоторые показатели липидного обмена у голодующих кроликов

<table>
<thead>
<tr>
<th>Число животных (a)</th>
<th>Время взятия крови (b)</th>
<th>Общий холестерин (c)</th>
<th>β-Липопротеиды (d)</th>
<th>Φ-липоидный фосфат (f)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M ± m</td>
<td>P</td>
<td>M ± m</td>
<td>P</td>
<td>M ± m</td>
</tr>
<tr>
<td>37 (b)</td>
<td>До голодаения</td>
<td>53,1±1,3</td>
<td>0,001</td>
<td>177,8±5,4</td>
<td>0,001</td>
<td>2,63±0,10</td>
</tr>
<tr>
<td>37 (b)</td>
<td>Через 3 дня от начала голодаения</td>
<td>87,6±2,2</td>
<td>0,001</td>
<td>220,0±7,0</td>
<td>0,001</td>
<td>3,38±0,10</td>
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<tr>
<td>37 (b)</td>
<td>Через 5 дней от начала голодаения</td>
<td>114,9±3,4</td>
<td>0,001</td>
<td>266,7±8,0</td>
<td>0,001</td>
<td>4,11±0,10</td>
</tr>
<tr>
<td>9 (b)</td>
<td>На 6-й день голодаения: 1-я группа — контрольная</td>
<td>125,8±5,7</td>
<td>0,001</td>
<td>291,7±6,9</td>
<td>0,001</td>
<td>4,84±0,23</td>
</tr>
<tr>
<td>19 (b)</td>
<td>2-я группа, на 6-й день получившая липиды трепанга</td>
<td>79,7±2,3</td>
<td>0,001</td>
<td>186,3±9,4</td>
<td>0,001</td>
<td>3,14±0,18</td>
</tr>
<tr>
<td>9 (b)</td>
<td>3-я группа, на 6-й день получившая белок</td>
<td>109,8±5,5</td>
<td>0,2</td>
<td>271,7±10,1</td>
<td>0,1</td>
<td>4,30±0,17</td>
</tr>
</tbody>
</table>

Effect of trepang lipids on some indicators of lipid metabolism of starving rabbits.

a—number of animals; b—time when blood samples were taken; b1—before starvation; b2—after 3 days of starvation; b3—after 5 days of starvation; b4—on the 6th day of starvation; b5—1st group (control group); b6—2nd group (received trepang lipids on 6th day); b7—3rd group (received albumin on 6th day).

c—total cholesterol; d—β-lipoproteins; e—lipoid phosphorus; f—phospholipids; g—cholesterol/phospholipids.
The determinations were made before the beginning of the experiment as well as on the 3rd, 5th and 6th days of the experiment. The obtained data were processed by the method of statistical distribution [literally: variational statistics, Tr.].

These studies indicated that the 5-day starvation period caused in the 37 rabbits a statistically significant increase in the content of cholesterol, β-lipoproteins and lipoid phosphorus. These data are presented in the Table.

The control group (9) continued to be starved another (the 6th) day during which we registered a statistically significant increase in the amount of cholesterol, β-lipoproteins and lipoid phosphorus. This change in the content of cholesterol, β-lipoproteins and lipoid phosphorus suggests the development of hypercholesteremia and corresponds with published data [2, 6, 7].

In the animals of the 2nd group (19), after the peroral administration of trepang lipids (0.2 g/kg) on the 5th day of the starvation period, we recorded a statistically significant decline in the level of cholesterol, β-lipoproteins and lipoid phosphorus. The level of these values was quite close to the original level, which is an indication of the effectiveness of the lipids.

An important factor that reflects the development of arteriosclerosis is not only the absolute increase in the amount of cholesterol but also the latter's relative predominance over the level of phospholipids [6]. In our experiments there was a statistically significant
increase in this coefficient (from 0.82 before the starvation period to 1.15 on the 6th day of starvation) in proportion to an increase in hypercholesteremia. In the animals of the 2nd group, which received trepang lipids, the cholesterol/phospholipids coefficient declined to 0.98, which is also an indication of the effectiveness of the lipids in question.

To exclude the energy effect of the administered lipids, we considered it necessary to introduce into the experiment the 3rd group of animals (9). The animals of this group, in contrast to the first two groups, were administered perorally on the 5th day of the starvation period egg albumin in an amount equivalent to the calories of the lipids. This only tended to reduce the content of cholesterol, β-lipoproteins and lipid phosphorus. These data are statistically insignificant.

Thus it can be noted that administration of general trepang lipids to starving rabbits suffering from hypercholesteremia normalizes lipid metabolism, which is an indication of the favorable effect of lipids.

References

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**Summary.** The hypocholesteremic effect displayed by the Japan Sea trepang is shown. The experiments were carried out on rabbits with hypercholesteremia caused by fasting. Total cholesterol, β-lipoproteids, lipoid phosphorus, total phospholipids and the cholesterol/ phospholipids ratio were determined in the blood of hypercholesteremic animals. The introduction of total trepang lipids to the hypercholesteremic fasting rabbits resulted in normalization of the lipids metabolism, this being indicative of the favourable effect produced by such lipids.