Hypolipidemic activity of silver preparations in chicks, *Gallus serregineus*

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Three silver preparations (Varak or foil, ash or Raupya bhasma and sol or colloidal solution) were fed to three groups of young, male chicks for 10 days. There was significant fall in all the plasma lipid fractions—total lipids, phospholipids, triglycerides and total cholesterol. There was a marked rise in silver content of plasma and whole blood, ranging from 4 to 13 times, suggesting that the observed hypolipidemic action may be due to silver. The administration of the three silver preparations did not cause any retardation in growth, toxic manifestation, side effect or untoward reaction.

**Keywords:** Cholesterol, Lipids, Phospholipids, Raupya bhasma, Silver sol, Silver varak, Triglycerides

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Silver and its compounds are not used internally in modern medicine, but externally they have long been used as astringent, antiseptic, disinfectant, anti-bacterial, germ killer and in wound healing, to treat infection, purify water and preserve beverages. On the contrary, silver has been widely used for therapeutic purposes in Ayurvedic system of medicine which considers it as a tonic, stimulant, aphrodisiac and good for the heart. In Ayurved, silver varak (leaf/foil) and Raupya bhasma (ash) are highly recommended in excessive heat in the body, hectic fever, tuberculosis, chest affections, impotence, obesity, painful and irritable condition of the stomach and intestines, in heart burn, chronic diarrhoea, uterine diseases, such as, leucorrhoea and menorrhagia. Therefore, silver and its bhasma are present in several remedies, viz., Jayamangala Rasa, Vrihat Vata Gajankusa, Mahalakshmiibilas Rasa, Kanchanabhra, Swasa Gajankusa, etc.

The Unani system of medicine also uses silver for therapeutic purpose. A preparation, similar to Ayurvedic bhasma and known as Kuksa Nuqra, is considered aphrodisiac and cardiac, hepatic and nervine tonic; it is claimed to be useful in inflammatory conditions and neuralgia.

Silver varak (leaf/foil) is prepared by beating silver wire into extremely thin leaves. These are largely used in decorating sweets and betels in India and cakes and confectionery in the west. Apart from it, many Indians drink water and milk kept in silverware as it is believed to be good for health and longevity.

Significant hypolipidemic, hypotriglyceridemic, hypcholesterolemic and hypoglycemic effects of feeding silver foil/leaf were reported by Sharma et al. The present communication reports effect of silver in three different forms—metallic (foil), colloidal (sol) and complex (ash) in chicks.

**Materials and Methods**

One month old, young male chicks (*Gallus serrugineus*) of about one kg body weight were purchased from local poultry. They were divided into four groups, of 25 each. The chicks of group one served as control. They were sacrificed together with the chicks of experimental groups. All the chicks were fed normal “Finisher Mash” diet and water *ad libitum*.

Chicks of second group were fed 15 mg silver foil mixed with about 1 g of milk cake (*mawa* sweet) everyday for 10 days, and then sacrificed on 11th day. The chicks of third group were fed a wheat flour dough pellet containing 2 mg silver ash everyday for 10 days and sacrificed on 11th day. The chicks of...
fourth group received 2 ml of silver sol orally by a syringe. This dose was equivalent to 0.4 mg silver. The sol was regularly given for 10 days and the chicks were finally sacrificed on the next day.

All the chicks were sacrificed by cutting the jugular vein and the blood was collected in a heparinized vial. The separated plasma was used to estimate total lipids, phospholipids, triglycerides, total cholesterol and HDL-cholesterol. Both the plasma and the whole blood, were also analyzed for silver content by atomic absorption spectrophotometer after dry ashing in a muffle furnace followed by dissolution in nitric acid.

Silver foil was purchased directly from the manufacturer in Jaipur market. On analysis it was found to contain 99.5% silver. This analysis was done by Volhard’s method after dissolution of a weighed piece of foil in nitric acid.

Silver sol was prepared by reduction of silver nitrate solution by ascorbic acid and using gelatin as a protective colloid. It was appropriately diluted to bring its silver content to 0.2 mg/ml. The absorption maxima of this brown red coloured sol was at 426 nm. The stability of gelatin-protected sol was checked by noting the absorbance at 426 nm in a spectrophotometer. The analysis of silver content of the sol was done in an atomic absorption spectrophotometer by directly aspirating the sample in the flame.

Silver bhasma (ash) was prepared by heating silver foil with twice its weight of cinnabar in a subliming apparatus wherein mercury vaporizes and collects in the upper vessel while silver ash remains in the lower vessel.

Silver ash was a jet black powder resembling charcoal. It was homogeneously mixed with wheat flour and dough was prepared; which was divided into equal parts to form pellets so that 2 mg ash was present in each pellet.

The mineral content of ash was determined by atomic absorption spectrophotometer, except, sodium and potassium, which were determined by flame photometer. For this purpose, a weighed amount of silver ash was dry ashed at 700°C for 5 hr in a silica crucible in a muffle furnace; cooled; dissolved the residue in concentrated nitric acid and diluted with deionised water. The analysis of carbon, hydrogen and nitrogen was done by Regional Sophisticated Instrumentation Center (RSIC) of Central Drug Research Institute, Lucknow.

**Results and Discussion**

Although heavy metals are considered toxic, there was no sign of toxicity to the chicks by either of the preparation. The chicks were healthy, alert and playful. No retardation in growth was seen as was observed by Hill et al. in chicks fed 100 and 200 ppm of silver sulphate. In fact, the chicks grew in weight. The differences in this observation may be due to chemical form of the silver or the dose. Lack of toxicity, side effect or untoward reaction was also observed in the earlier study in humans given silver foil, along with absence of any abnormality in urine.

The effect of three silver preparations on plasma lipids of chicks is presented in Table 1. There was highly significant fall in total lipids of plasma in all the three experimental groups as compared to control group. The per cent average fall was more or less to the same extent. Similarly, phospholipids level was also decreased significantly by administration of the three silver preparations. The hypophospholipidemic action of silver was most pronounced in case of ash.

### Table 1—Plasma lipid profile following administration of silver preparation

<table>
<thead>
<tr>
<th>Lipid Fraction (mg/dl)</th>
<th>Control Group</th>
<th>Foil</th>
<th>Ash</th>
<th>Sol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lipids</td>
<td>518.8 ± 12.4</td>
<td>437.0 ± 9.9 ±15.7</td>
<td>422.4 ± 11.3 ±18.5</td>
<td>434.7 ± 10.0 ±16.2</td>
</tr>
<tr>
<td>Phospholipids</td>
<td>217.0 ± 9.2</td>
<td>189.3 ± 6.4 ±12.7</td>
<td>171.6 ± 7.5 ±22.8</td>
<td>175.9 ± 6.6 ±18.9</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>115.7 ± 6.7</td>
<td>71.9 ± 5.8 ±37.8</td>
<td>44.5 ± 5.1 ±61.5</td>
<td>58.2 ± 4.8 ±49.7</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>145.4 ± 5.3</td>
<td>120.8 ± 3.7 ±16.9</td>
<td>128.9 ± 2.9 ±11.3</td>
<td>100.0 ± 3.5 ±31.2</td>
</tr>
<tr>
<td>HDL-cholesterol</td>
<td>44.4 ± 3.0</td>
<td>53.6 ± 2.8 ±20.7</td>
<td>70.5 ± 2.5 ±58.7</td>
<td>22.2 ± 1.7 ±50.0</td>
</tr>
</tbody>
</table>

*P values: *< 0.05; *< 0.01; *< 0.001
followed by sol and then foil. A highly significant fall in triglycerides was observed in the three experimental groups with the same pattern of efficacy as observed in phospholipids. On the contrary, although all the three preparation exhibited highly significant hypocholesterolemic effect, the sol was most effective, followed by foil and then ash. The effect of silver preparations on HDL-cholesterol was varied. The foil and the ash significantly increased HDL cholesterol (ash being more effective), while sol significantly decreased HDL-cholesterol. The association of blood lipids (especially cholesterol) and atherosclerosis is amply confirmed. The reduction in total cholesterol by any agent has beneficial effect in regression of atherosclerosis. For reduction of triglycerides, ash was most effective. On the other end, sol was most effective for reducing total cholesterol. Although sol also decreased HDL-cholesterol, along with total cholesterol, this does not preclude its possible use as an hypocholesterolemic agent, because drugs like probucol are in use which decrease HDL-cholesterol as well as LDL-cholesterol.

The mechanism of reduction of triglycerides and cholesterol is not known. Silver being a heavy metal, may affect enzyme/s concerned with their synthesis. This speculation is supported by recent report of Konjiku et al., who found that feeding copper supplement (63,180 mg/kg) in the form of cupric citrate or cupric sulphate for 21 days to chickens resulted in reduced level of cholesterol in plasma, liver and thigh muscle. They also found that the activity of fatty acid synthetase and cholesterol 7-α-hydroxylase were also decreased. Since copper and silver are in the same group of periodic table of elements, their properties are expected to be similar.

The silver content of foil was 99.5%; ash, 42.8%; and sol, 0.2 mg/ml. Silver bhasma manufactured by M/S Baidyanath Ayurved Bhawan, Jhansi, contained 49.7% silver. The percentage of other elements in our ash were: Cu, 0.51; Fe, 0.24; Zn, 0.33; Ca, 0.36; Mg, 0.44; Na, 16.56; K, 2.96; C, 6.51; H, 0.19 and N, 0.0. The rest of the material amounted to 29.10% including oxygen and sulphur.

That silver was actually absorbed from these three preparations to exert hypolipidemic action is supported by substantial rise in silver content of plasma and whole blood (Table 2). The rise varied from 4.4 to 10 times in plasma and 4.7 to 13.1 times in whole blood. In both the fluids greatest rise occurred with sol, and least with foil. Ash gave slightly more rise than foil. This is not surprising because colloidal solutions are known for their better absorbability and lesser toxicity.

This study indicates that each of these three silver preparations can be safely used in clinical trials as lipid lowering agent.

References
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