

- B77, 131.
52. Parthasarathi, K. and Rangaswamy, C. R., *Experientia*, 1981, 37, 448.
 53. Parthasarathi, K. and Ramswamy, M. N., *J. Sci. Ind. Res.*, 1961, 20C, 273.
 54. Parthasarathi, K., Babu, D. R. C. and Rao, P. S., *Proc. Indian Acad. Sci.*, 1970, 72B, 277.
 55. Parthasarathi, K., Rangaswamy, C. R., Babu, D. R. C. and Rao, P. S., *Indian Phytopathol.*, 1975, 28, 352.
 56. Parthasarathi, K., Ramaiah, P. K. and Rao, P. S., *Proc. Indian Acad. Sci.*, 1963, B57, 68.
 57. Parthasarathi, K., *Indian For.*, 1979, 105, 356.
 58. Varadaraja Iyengar, A. V., *J. Indian Inst. Sci.*, 1933, 16A, 139.
 59. Ramaiah, P. K., Babu, D. R. C. and Rao, P. S., *Proc. Indian Acad. Sci.*, 1964, B60, 281.
 60. Varadaraja Iyengar, A. V., *J. Indian Inst. Sci.*, 1938, 21A, 89.
 61. Parthasarathy, K., Gupta, S. K. and Rao, P. S., *Proc. Indian Acad. Sci.*, 1966, B64, 152.
 62. Nayar, R., *J. Indian Acad. Wood Sci.*, 1977, 8, 41.
 63. Rao, P. S., Srimathi, R. A., Nag, K. C., Raychaudhuri, S. P., Ghosh, S. K., Chenulu, V. V. and Anupam Varma, *Proc. Indian Nat. Sci. Acad.*, 1975, 41B, 340.
 64. Rao, P. S., Srimathi, R. A. and Nag, K. C., *Curr. Sci.*, 1972, 41, 221.
 65. Nayar, R. and Ananthapadmanabha, H. S., *J. Indian Acad. Wood Sci.*, 1974, 5, 108.
 66. Muthanna, M. A., *Indian For.*, 1955, 81, 500.
 67. Anon, *Annual Report of Silvicultural Research in Madras State for the year 1951-52*, 1952.
 68. Rangaswamy, S. and Griffith, A. L., *Indian For.*, 1939, 65, 335.

EFFECTS OF ONION IN INDUCED ATHEROSCLEROSIS IN RABBITS: II. REDUCTION OF LIPID LEVELS IN THE EYE†

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ABSTRACT

The influence of onion extract on the lipid levels of the eye in hypercholesterolemic rabbits has been studied and a comparison has been made with rabbits on cholesterol enriched diet alone and with normal controls. The results show that the total lipids, cholesterol and phospholipids are significantly higher in animals on cholesterol diet than in animals on cholesterol and onion extract diet. The lipid levels in the latter group are comparable to the levels of the control group.

THE ocular damage during hypercholesterolemia has been observed in rabbits and human subjects. In rabbits the lipid deposition in the iris appears earlier and is more conspicuous than the involvement of cornea¹⁻³. Similar changes involving the deeper structures of the eye have also been reported⁴⁻⁷. Ocular symptoms such as acute juvenilis and lipid keratopathy have been observed during familial hypercholesterolemia with massive snowball like exudation of cholesterol in vitreous⁸.

The effects of various regressive agents have generally been reported on the aortic lesions and the associated lipid levels⁹⁻¹⁴, but to our knowledge the effects of these regressive agents on the eye lipid levels have not been reported. Therefore, in the present study the effect of onion extract, which reduces

significantly the aortic lesions and lipid levels¹⁵, maintaining the normal shape of erythrocytes at the varied levels of plasma constituents¹⁶⁻¹⁹, on the lipid levels in the eyes of the rabbits fed with hypercholesterolemic diet, is determined and compared with the normal controls.

White albino rabbits of same age, weight and sex are fed with normal diet (carrot, cabbage and greens) and divided into three groups (ten animals in each group). Group I served as normal control; Group II rabbits are fed with atherogenic diet (normal diet plus 0.5% cholesterol) and Group III are given atherogenic diet as above and extract of 20 g fresh onion, prepared by the method of Stoll and Seebeck²⁰. Plasma cholesterol levels are maintained at 1000-1400 mg% by the dietary adjustment of cholesterol. At the end of six months, the rabbits are sacrificed.

The total lipids are extracted by the method of Folch *et al*²¹. Plasma and eye cholesterol are determined by the method of Abell *et al*²². The lipid

†This work was carried out at the Biomedical Engineering Division, Indian Institute of Technology, Madras, India.

TABLE I

Lipid contents of plasma in various groups (mg%)

Group	Total lipids	Cholesterol	Phospholipids	C/P
I	1000.0 ± 125.0 ⁺	141.8 ± 32.4	135.8 ± 19.34	1.04
II	5308.0 ± 1200.0	1228.0 ± 360.8	249.0 ± 24.12	4.93
III	3597.0 ± 450.7	1148.0 ± 310.8	409.7 ± 29.0	2.80

+ Mean ± s.d.

phosphorus is determined by the method of Fiske and Subbarow²³ and is multiplied by 25 to obtain phospholipid levels.

Table I shows the plasma lipid levels in various Groups. The cholesterol levels in Groups II and III are comparable, whereas the levels of other lipids show variations. The increase of cholesterol to phospholipids ratio (C/P) in Groups II and III compared to Group I is significant ($p < 0.001$). This ratio is generally found to be greater than one for the atherosclerotic animals. With the increase of this ratio, the involvement of the tissues in atherosclerotic lesions also increases. Based on this, the lesions in Group II should be more than the other groups. This has recently been confirmed by our observations on the aortic tissues obtained from the animals of various groups¹⁵.

TABLE 2

Lipid content of the eye in various groups (mg/g wet tissue)

Group	Total lipids	Cholesterol	Phospholipids
I	8.9 ± 1.2 ⁺	1.0 ± 0.2	3.5 ± 0.9
II	32.6 ± 4.7	12.9 ± 2.3	5.4 ± 1.2
III	10.4 ± 2.5	1.1 ± 0.2	5.2 ± 0.6

+ Mean ± s.d.

The levels of total lipids, cholesterol and phospholipids in the eye tissues are given in table 2. The cholesterol level in Group II, compared to other groups, has significantly increased ($p < 0.001$). A comparison between Groups II and III indicates that the onion extract is effective in reducing the tissue cholesterol level in the eye tissues (90%). This reduction is more compared to that in the aortic tissues (69%). The difference in cholesterol reduction in these organs could be attributed to the variation in the flow patterns through these organs²⁴⁻²⁶.

The detailed mechanism(s) responsible for this regressive effect of onion extract is still under investigation. It appears from the observations reported so far that the onion extract might be

effective in lowering the levels by its action on
(a) Erythrocytes — as observed by normal appearance and normal hemolytic tendency.
(b) Cardiovascular system—presence of onion factors in touch with the organ, thus providing a protective mechanism at the various sites.

The normal characteristics of the erythrocytes maintain the normal oxygen supply to the tissues and this may help to lower the lipid levels in Group III, comparable to normal controls. It has been observed that in Group II rabbits, the erythrocytes shape and their characteristics are significantly altered and hematocrit level is also decreased¹⁸. Due to these changes the tissues may be subjected to hypoxic conditions. This is in addition to the increased levels of the plasma cholesterol, which finally lead to atherosclerotic conditions. Similar findings under hypoxia, associated with cholesterol feeding, leading to the pronounced worsening of edema, medial thickening and degradation of vascular lesions, have been reported²⁷⁻²⁸.

Thus it is suggested that the onion extract (composed of several sulphur containing compounds) is effective in lowering the lipid levels in the eye as well as in other organs in rabbits. Its effect may be due to oxygen transport to tissues through erythrocytes. The other possible mechanism involved in the protective process through the interaction with various constituents cannot be overruled. The detailed mechanism of its action is under investigation and will be reported shortly.

1. Verse, M., *Virchow's Arch. Path. Anat.*, 1924, 250, 252.
2. Cogan, D. G. and Kuwabara, T., *Arch Ophthalmol.*, 1959, 61, 219.
3. Friedman, M. and Byers, S. C., *Am. J. Physiol.*, 1959, 197, 842.
4. Janes, R. G., *Am. J. Ophthalmol.*, 1964, 58, 819.
5. McLaren, D. S., In: *Biochemistry of the eye* (Ed. C. N. Graymore) New York, Academic Press, 1970, p. 547.
6. Walton, K. W., *J. Pathol.*, 1973, 111, 263.
7. Walton, K. W. and Dankerley, D. J., *J. Pathol.*, 1974, 114, 217.

8. Graymore, C. N., *Biochemistry of the eye*, New York, Academic Press, 1970, p. 503.
9. Hollander, W., Kramsch, D., Franzblau, C., Paddock, I. and Colombo, M., *Circ. Res.* 1974, **34**, Supp. 1, 131.
10. McCullagh, K. G., Erhart, A. and Butkus, A., *Lab. Invest.*, 1976, **34**, 394.
11. Bratsand, R., *Artery*, 1977, **3**, 336.
12. Stafford, W. W. and Day, C. E., *Artery*, 1975, **1**, 106.
13. Enomoto, H., Yoshikuni, Y., Saito, K., Ozaki, T., Ohata, K. and Zschoke, R., *Atherosclerosis*, 1978, **30**, 109.
14. Shimamoto, T., *Blood Vessels*, 1978, **15**, 170.
15. Vatsala, T. M., Singh, M. and Murugesan, R. G., *Artery*, 1980, **7**, 519.
16. Vatsala, T. M. and Singh, M. *Curr. Sci.*, 1979, **48**, 797.
17. Vatsala, T. M., and Singh, M., *Atherosclerosis*, 1980, **36**, 39.
18. Vatsala, T. M. and Singh, M., *Biorheology*, 1980, **17**, 261.
19. Vatsala, T. M., and Singh, M., *Curr. Sci.*, 1981, **50**, 519.
20. Stoll, A. and Seebeck, E., *Adv. Enzymol.*, 1951, **11**, 377.
21. Folch, J., Lees, M. and Stanley, G. H. S., *J. Biol. Chem.*, 1957, **226**, 497.
22. Abell, L. L., Levy, B. B., Brodie, B. B. and Kendall, F. E., *J. Biol. Chem.*, 1952, **195**, 355.
23. Fiske, C. H. and Subbarow, Y., *J. Biol. Chem.*, 1925, **66**, 375.
24. Fry, D. L., *Circ. Res.*, 1968, **22**, 165.
25. Jorgensen, L. and Swendsen, I., In: *International Conf. on Atherosclerosis* (Ed. L. A. Carlson), New York, Raven Press, 1978, p. 561.
26. Jorgensen, L., *ibid*, p. 615.
27. Kjeldson, K., Wanstrup, J. and Astrup, P., *J. Atheros. Res.*, 1968, **8**, 835.
28. Boatman, J. B. and Carter, S. B., *Arch. Environ. Health*, 1973, **27**, 360.

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