

### Influence of Protein or Cystine Intake on Cataract-producing Action of Galactose.\*†

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Ever since it was first demonstrated that galactose causes lens changes in rats<sup>1</sup> experiments have been under way in an effort to explain the metabolic disturbances involved. The basal ration of 15% protein, 70% carbohydrate (galactose and starch), 11% fat (including 2% cod liver oil), 4% salt mixture (Osborne and Mendel), and 0.5 gm. dry yeast 3 times a week, has been modified and supplemented in various ways. The following mineral and vitamin modifications have failed to alter the incidence or speed of cataract development; an excess or omission of salt mixture, drastic shifts in the acid-base balance of the ration, excess or lack of vitamins B and G, crystalline ascorbic acid administered orally or parenterally, massive doses of viosterol. Modifications in the types and amounts of fat or carbohydrate (other than galactose or lactose) have also given negative results. An increase in the amount of protein (15% to 30%) from 3 different sources (casein, lactalbumin, and beef muscle, respectively) also failed to alter the rate of cataract development.

A reduction of the protein (casein), however, in a 25% galactose ration, from the regular 15% level to 5% level shortened the time of cataract development from 26.3 to 15 days on the average, a difference which is strikingly significant. Furthermore, growth of rats on the low protein ration was limited, as would be expected, and the lower food intake in this group meant less galactose actually consumed, which fact tends to make the aggravating effect of the low protein still more striking. It is worth noting that an increase of galactose in the basal ration from 25% to 35% is less effective in shortening the time of cataract development than is the lowering of the protein from 15% to 5%.

The loss of cystine and other sulphur-containing compounds from

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<sup>1</sup> Mitchell, H. S., *PROC. SOC. EXP. BIOL. AND MED.*, 1935, **32**, 971.

cataractous lenses as reported in the literature<sup>2-4</sup> would suggest that cystine or a related substance may play an important rôle in the

TABLE I.  
Cataract Development on a 25% Galactose Ration Modified as to Protein and Cystine Content. (Read across for comparison of litter mates.)

Litter No.	15% casein Control ration		5% casein		15% casein +1% cystine		15% casein +2% cystine		15% casein +3% cystine	
	No. Rats	Mature of Cataract days*	No. Rats	Mature of Cataract days*	No. Rats	Mature of Cataract days*	No. Rats	Mature of Cataract days*	No. Rats	Mature of Cataract days*
67	1	22.0 (21-23)			2	26.8 (21-35)				
68	2	19.2 (18-21)			2	22.0 (18-28)	2	25.2 (21-32)	2	31.5 (25-37)
93	2	24.2 (19-35)	4	13.0 (13-13)						
96	2	47.0 (31-58†)	2	19.2 (15-23)						
97	2	23.2 (16-32)	4	15.5 (13-19)					2	28.0 (26-32)
98	2	21.2 (21-22)	2	16.8 (14-20)					2	25.2 (21-28)
99	2	37.0 (24-49†)	2	17.2 (14-19)			2	40.0 (31-49†)	2	40.0 (28-49†)
101	1	18.5 (18-19)	2	12.5 (12-13)	2	21.2 (19-25)	2	22.7 (21-24)		
102	1	19.0 (18-20)	2	12.2 (11-13)						
103	1	21.0 (20-22)	2	16.0 (13-19)						
104	2	15.2 (15-16)	1	13.5 (13-14)	2	19.0 (19-19)	2	21.8 (19-24)	2	20.2 (19-22)
105	1	20.0 (20-20)			2	24.2 (20-26)	2	22.8 (20-26)	2	27.0 (26-28)
Average days for modified rations groups			21	15.0	10	22.6	10	26.6	12	28.6
Incidence of cataract %			100	100	100	100	90	90	92	92
			Controls		Controls		Controls		Controls	
Average days for litter mates in each group on the control ration			15	26.3	7	18.4	8	22.6	11	23.0
Incidence of cataract %			87	87	100	100	88	88	91	91

\*Time required for lens changes to become visible to the naked eye (mature cataract). Average and range given for each group.

† Two eyes in each case failed to show mature cataract but did show advanced lens changes at the end of the experimental period. The number of days on the cataract producing ration were used in calculating the time factor for these few animals.

<sup>2</sup> Fisher, F. P., *Arch. f. Augenh.*, 1934, **108**, 527.

<sup>3</sup> Shoji, Y., *Arch. d'Ophth.*, 1931, **48**, 28.

<sup>4</sup> Weinstein, P., *Arch. f. Augenh.*, 1935, **109**, 221.

metabolism of the lens. Small supplements of cystine used in some preliminary experiments (0, 1-0.25%) gave negative results. Subsequently larger amounts of cystine (1, 2, and 3%) have been employed and the higher levels do appear to have a slight inhibitory effect upon the cataract-producing action of a 25% galactose ration. Bellows' observation<sup>5</sup> of an inhibitory effect when 0.3% cystine was added to a 35% galactose ration is interesting but not convincing because his data are too few and his experiments insufficiently controlled in view of litter differences usually encountered.

The accompanying table is given by litters so that, by reading across, comparisons may be made between litter mates. Each litter was started on experimental rations at 25 days of age. The time differences in cataract development between litter mates on various rations are more striking than average differences. Only figures from litter mate controls have been used in computing averages as given. The phenomenon of cataract-resistant and cataract-susceptible litters, even within a given strain of rats, must be recognized and considered in planning and controlling this type of experiment.

From these data it is evident that a protein deficiency definitely hastens the development of galactose cataract. The relatively slight inhibitory effect of a 20-fold increase in the cystine content of the ration makes it doubtful whether cystine is the crucial factor and leaves the question open as to what other factors may play equal or even more important rôles in this respect.

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### **Serum Protein Changes Occurring in Degenerative Stages of Bright's Disease.**

ELOISE JAMESON. (Introduced by T. Addis.)

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Many studies have been made of the changes in serum proteins during the degenerative stages of Bright's disease which are accompanied by edema and a high loss of protein in the urine. In general these studies have been confined to the total serum protein and the albumin-globulin ratio. The results have shown a low total protein and a lowered albumin to globulin ratio.

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<sup>5</sup> Bellows, J., *Arch. Ophth.*, 1936, **16**, 762.