HYSTERESIS IN SORPTION XVII. HARDENING OF SERICIN AND ITS INFLUENCE ON SORPTION-DESORPTION HYSTERESIS.*

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INTRODUCTION.

The behaviour of cereals (Rao, K. S., 1939), gum arabic (Rao, K. S., 1940) and proteins (Rao, G. N., Rao, K. S. and Rao, B. S., 1947) in the sorption of water has been indicated. The hysteresis effect initially exhibited disappears after a certain number of cycles of sorption and desorption. This disappearance of the hysteresis effect is due to the swelling of the organo gels in water and the consequent loss of the entrapping effect.

Proteins can be hardened (Masami Oku and Jiro Hirose, 1938) by the various hardening reagents. The effect of hardening of sericin on the sorption-desorption hysteresis has been presented in this paper.

EXPERIMENTAL.

Extraction of sericin.

Sericin was extracted by heating raw silk in water at 120° C. in an autoclave. Sericin was precipitated from the colloidal solution by freezing and subsequent thawing. The precipitated sericin was separated and dried in air at room temperature for 48 hours.

Hardening of sericin.

Formaldehyde hardening.—Five grams of air dried sericin powder was put into 100 c.c. of 0·5% formaldehyde. The solution was acidified with hydrochloric acid to give a final concentration of 2%. The mixture was kept for 24 hours. The sericin was separated and dried.

Chrome hardening.—Basic chromium sulphate was prepared by mixing 50 c.c. of 0·1 molar chrome alum solution and 50 c.c. of 0·1N sodium hydroxide (Williamson, F. S., 1923). Five grams of sericin powder were kept in 100 c.c. of this basic chromium sulphate solution for 24 hours. After this treatment, sericin was separated, washed and dried in air at room temperature for 48 hours.

Sorption-desorption hysteresis.

The hardened as well as unhardened samples of sericin were dehydrated in vacuum at 60° C. for 6 hours. The dehydrated sericin was next introduced into the

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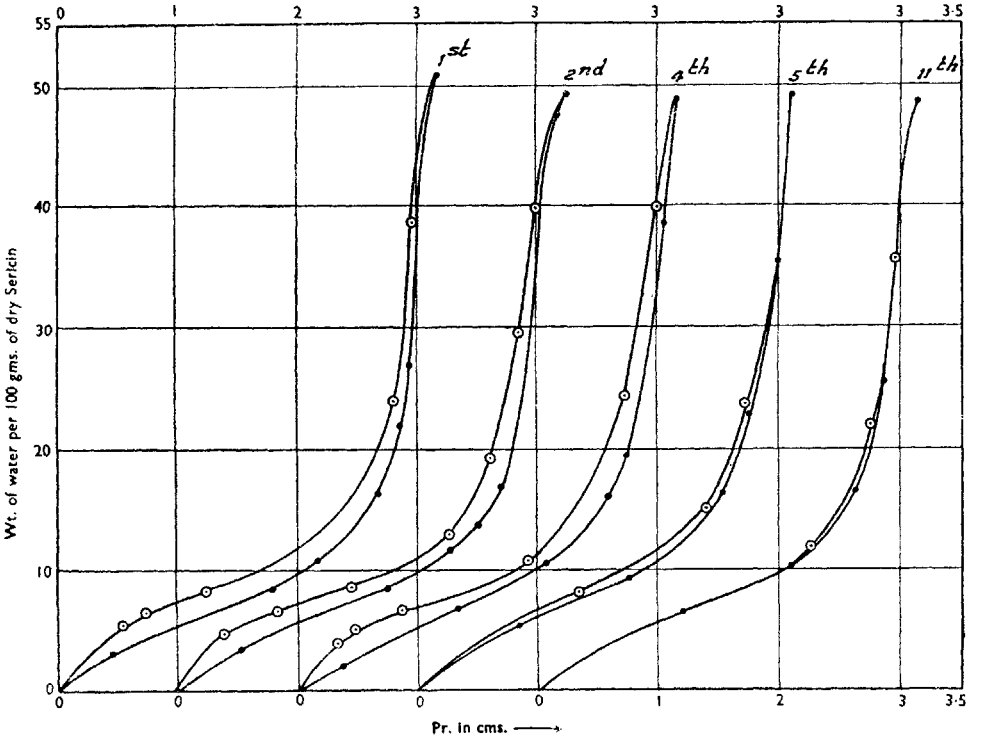

FIG. 1.

Sorption-desorption Hysteresis of water on unhardened sericin at the 1st, 2nd, 4th, 5th and 11th cycles.

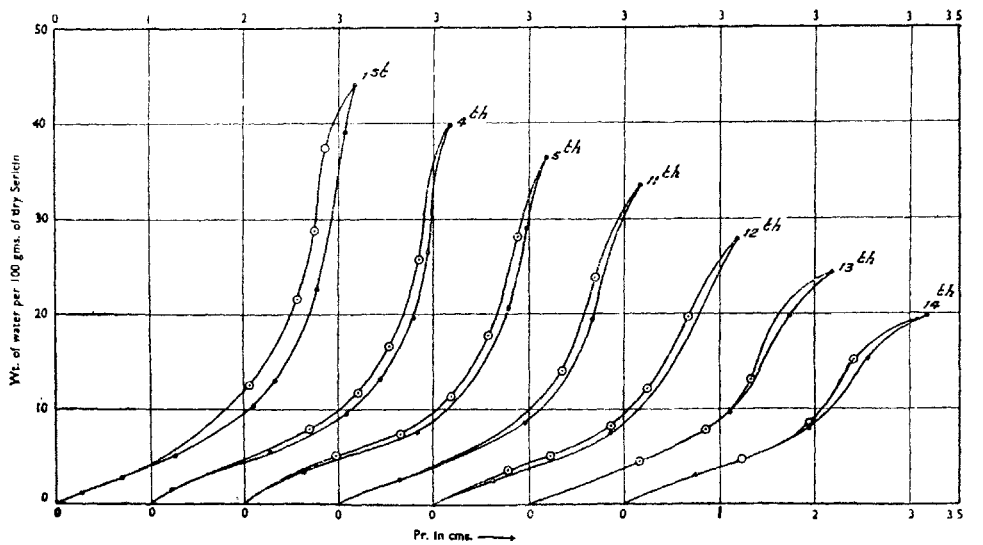

FIG. 2.

Sorption-desorption hysteresis of water on sericin (formaldehyde hardened) at the 1st, 4th, 5th, 11th, 12th, 13th and 14th cycles.

quartz fibre spring balance (Rao, K. S., 1941) and was subjected to successive sorption and desorption at 30° C. The results are indicated in Figs. 1–3. About 8–10 hours were allowed for the attainment of equilibrium and each cycle took about 8 days.

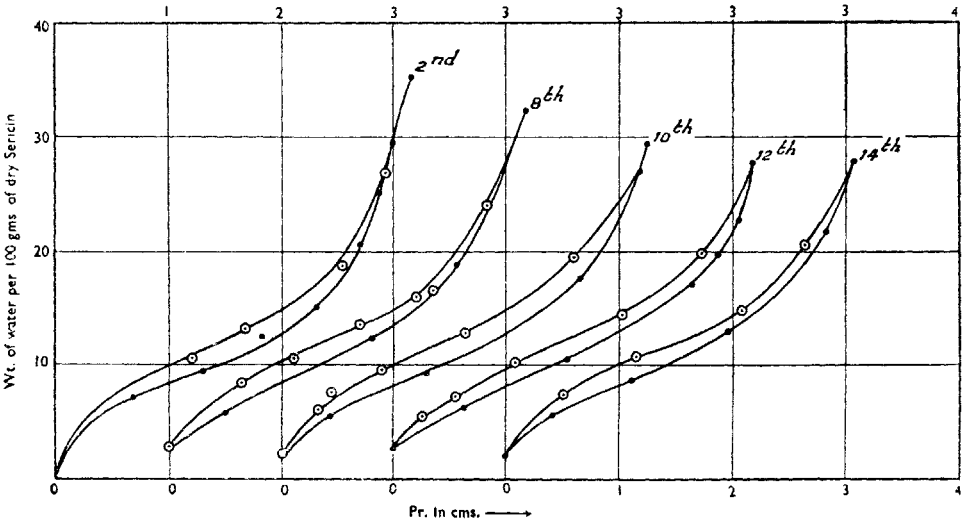

FIG. 3.

Sorption-desorption Hysteresis of water on sericin (Chrome hardened) at the 2nd, 8th, 10th, 12th and 14th cycles.

DISCUSSION.

Unhardened sericin.

Sericin like casein, egg albumen and gelatin (Rao, G. N., Rao, K. S. and Rao, B. S., 1947) exhibits the hysteresis effect in the initial stages, Fig. 1. The loop decreases in size on successive sorption and desorption and finally disappears.

The sorption and desorption processes were continued up to 11th cycle. In the dehydrated condition, sericin has cavities of fairly rigid walls. The cavities entrap water and cause hysteresis. On exposure of sericin to water vapour, water is absorbed and later imbibed. Sericin swells like other organo gels on the imbibition of water. The cavity walls now become elastic and yield during desorption. The cavities disappear. The entrapping effect is thus lost and hysteresis disappears.

Hardened sericin.

Sericin hardened by formaldehyde or by basic chromium sulphate behaves differently. In a series of sorption and desorption operations, the hardened sericin exhibits the hysteresis effect and the effect persists in the subsequent cycles of sorption and desorption. The sorption and desorption processes were continued up to 14th cycle, Figs. 2 and 3.

On hardening, sericin behaves more like a rigid gel. The swelling property is either lost or diminished. The rigidity of the cavity wall remaining practically unaltered on successive sorption and desorption, the cavities retain the entrapping effect and the hysteresis loop persists even after a number of cycles.

The above results in conjunction with those on grains (Rao, K. S., 1939, Rao, K. S., 1941), plant exudate (Rao, K. S., 1940) and proteins (Rao, G. N., Rao, K. S. and Rao, B. S., 1947) already published bring out clearly the rôle of the swelling property of the absorbent in the disappearance of the sorption-desorption hysteresis.

SUMMARY.

Sericin has been hardened by (1) formaldehyde and (2) basic chromium sulphate.

On the hardened and unhardened samples of sericin, sorption and desorption of water vapour at 30° C. have been conducted. Sericin hardened by formaldehyde or basic chromium sulphate shows the hysteresis effect which persists in the subsequent cycles. Whereas, the unhardened sericin shows a hysteresis loop which decreases in size in the subsequent cycles of sorption and desorption and finally disappears. These results indicate that hardened sericin behaves like a rigid gel, whereas unhardened sericin is an elastic gel like gelatin, casein, egg albumen and gum arabic.

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