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THE EFFECT OF HEAT ON TRAGACANTH AND ITS MUCILAGE.*

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The consistency of Mucilage of Tragacanth varies greatly when it is prepared under different conditions. The mucilage made without the application of heat is decidedly more fluid than the mucilage subjected to boiling for several minutes.

If the mucilage is boiled for 15 minutes, a very fluid preparation results. On the other hand, when the mucilage is boiled but two minutes, it remains viscous. Further, an increase in viscosity has been noted upon aging the mucilage prepared by bringing it to a boil, and then removing the source of heat.

These facts prompted the investigation presented in this paper.

Evers and MacLachlan (*Year Book of Pharmacy (British)* (1927), 504) generalized upon the above facts, but apparently did not investigate the range of viscosity changes produced in the Mucilage of Tragacanth when it is subjected to varying boiling periods.

The object of these experiments was twofold: (1) To secure a mucilage which will remain constant in viscosity. (2) Production of a mucilage of maximum viscosity.

The mucilage used in all the experiments conducted for this paper was prepared from the following formula:

Powdered Tragacanth	54 grains
Glycerin	2 ounces, avoird.
Water (60° C.), to make	8 ounces avoird.

The powdered tragacanth was mixed in a mortar with the glycerin and 6 fluid-ounces of water (60° C.) added slowly with constant stirring. The mucilage was transferred to a tared casserole and the mortar rinsed with a small amount of water, and the rinsing added to the mucilage in the casserole.

The following variations of time of boiling were established:

- | | |
|---|----------------------------|
| 1. No application of heat | 8. Boiled six minutes |
| 2. Mucilage brought to a boil (required four minutes for each experiment) | 9. Boiled seven minutes |
| 3. Mucilage boiled one minute | 10. Boiled eight minutes |
| 4. Boiled two minutes | 11. Boiled nine minutes |
| 5. Boiled three minutes | 12. Boiled ten minutes |
| 6. Boiled four minutes | 13. Boiled twelve minutes |
| 7. Boiled five minutes | 14. Boiled fifteen minutes |

The following regulations were maintained throughout all the experiments: The casserole containing the mucilage was placed on a tripod, supported by an

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asbestos-centered wire gauze and held three and a half inches above the top of the Bunsen burner. The burner was regulated to deliver a 7-inch flame and all the mucilages were boiled vigorously, with the same intensity of heat applied on each experiment.

At the conclusion of the boiling period the mucilage in the tared casserole was weighed and sufficient water added to bring the weight of the mucilage to eight ounces. In experiments No. 5 to No. 14, sufficient excess of water was added when the mucilage was prepared to balance the loss of water due to evaporation over the longer boiling periods. A preservative was added to all experiments. The experiments were transferred to bottles, corked and allowed to stand one week before noting the viscosity of the mucilage.

The viscosity of the mucilage was determined by the use of the descending ball method and also by the MacMichael Viscosimeter. The descending ball method consisted of determining the number of seconds required for a standard metallic ball ($1/4$ -inch ball bearing—weight, 1.0446 Gm.) to descend through a six-inch column of the mucilage, at room temperature. The MacMichael Viscosimeter readings were obtained by noting the twist imparted to a standardized wire (No. 22) by action on a suspended disc plunger in the mucilage held in a container rotating at constant speed (8 r. p. m.).

The table below shows the results obtained by the above described methods on a series of four mucilages of each experiment.

TABLE I.

Length of time of boiling mucilage.	Viscosity of mucilage of tragacanth.				
	Descending ball method, no. of seconds required.	Average.	MacMichael viscosimeter.	Average.	
1. No application of heat	109, 115, 117, 106	112	151, 160, 151, 142	151	
2. Brought to boil	226, 245, 251, 233	234	193, 200, 181, 187	190	
3. Boiled 1 minute	340, 301, 315, 325	320	218, 214, 211, 201	211	
4. Boiled 2 minutes	330, 376, 318, 309	333	203, 217, 212, 190	205	
5. Boiled 3 minutes	272, 248, 307, 295	281	170, 158, 144	157	
6. Boiled 4 minutes	184, 168, 192	181	152, 163, 141	145	
7. Boiled 5 minutes	165, 156, 150	157	130, 148, 150	142	
8. Boiled 6 minutes	115, 140, 107, 122	121	130, 142, 146	137	
9. Boiled 7 minutes	45, 62, 44	50	100, 95, 125	107	
10. Boiled 8 minutes	24, 30, 23	26	78, 85, 65	76	
11. Boiled 9 minutes	16, 20, 21	19	87, 70, 64	73	
12. Boiled 10 minutes	11, 12, 19	14	54, 51	52	
13. Boiled 12 minutes	8, 6	7	44, 51	47	
14. Boiled 15 minutes	3, 4	4	28, 35	32	

The mucilages prepared without heating, and also the mucilages subjected to a boiling period greater than two minutes were decidedly more fluid than the mucilages boiled for one and two minutes. The viscosity of the mucilages drops sharply when boiled longer than the two-minute period.

The following curve shows the rapid increase in viscosity up to the two-minute boiling period, as well as the sharp decrease beyond this boiling time.

The abscissa represents the length of boiling time and the ordinate, in the case of the descending ball method, the number of seconds required for the ball to descend through a six-inch column of mucilage.

All the experiments recorded in the above table were returned to the bottles,

corked and allowed to age for three months. The viscosity determinations were repeated.

TABLE II.

Length of time of boiling.	Viscosity of mucilage of tragacanth after aging three months.	
	Descending ball method, no. of seconds required.	Average.
No application of heat	186, 201, 179, 177	181
Brought to boil	407, 347, 438, 399	398
Boiled 1 minute	618, 602, 555	592
Boiled 2 minutes	577, 396, 483, 519	501
Boiled 3 minutes	310, 351, 334	332
Boiled 4 minutes	130, 165, 135	142
Boiled 5 minutes	130, 149, 141	140
Boiled 6 minutes	105, 91, 92	96
Boiled 7 minutes	45, 73, 40	51
Boiled 8 minutes	26, 25, 19	23
Boiled 9 minutes	22, 17, 14	18
Boiled 10 minutes	7, 9	8

Marked increase in viscosity occurred in the mucilages prepared by boiling one minute, two minutes and also the experiments prepared by heating to 100° C.

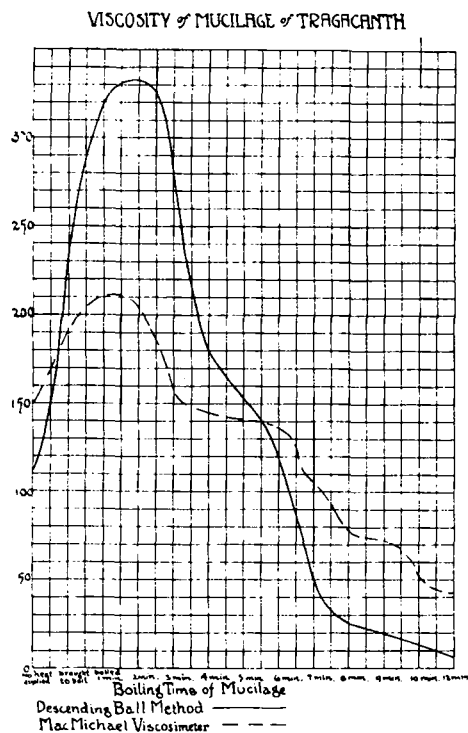
The three months' aging period revealed that the experiments subjected to one and two minutes' boiling produces a mucilage that thickens considerably on standing.

Experiments subjected to three minutes' boiling produce a mucilage which remains more uniform upon aging than all other experiments.

Comparing Table I with II, we find that the mucilage prepared by boiling three minutes gave an increase from 281 to 332 upon aging three months, whereas mucilages made by boiling one and two minutes, respectively, increased from 320 and 333 to 592 and 501, after standing three months.

EFFECT OF HEAT ON POWDERED TRAGACANTH.

Our attention was called to the fact that gum tragacanth of the same shipment varied greatly upon preparing mucilages with powdered gum selected from



different sections of the lot. One section of the shipment produced a mucilage of correct consistency, whereas another part of the same lot made a mucilage which was decidedly too fluid.

In the process of powdering the gum, considerable heat is developed. The tragacanth remains in the mill for a long period of time, and in the course of grind-

ing, sufficient heat evolves to produce a deleterious effect on the gum. The part lot of the tragacanth entering the mill last comes in contact with a greater degree of heat than the first section of the lot. Therefore, the mucilage prepared from the final section of the gum passing through the mill should be more fluid than the mucilage resulting from the first part of the lot.

Experiments were conducted to note the effect varying degrees of heat had upon powdered tragacanth. The formula for the mucilage used in the first part of this paper was adhered to in these experiments and all the mentioned regulations observed. Fifty-four-grain samples of selected powdered tragacanth were subjected to the following treatment:

- Four samples were dried over calcium chloride at room temperature.
- Four samples were heated at 45° C. for two hours.
- Four samples were heated at 45° C. for eight hours.
- Four samples were heated at 80° C. for two hours.
- Four samples were heated at 80° C. for eight hours.
- Four samples were heated at 100° C. for two hours.
- Four samples were heated at 100° C. for eight hours.

The samples of the powder were removed from the source of heat, and the mucilage prepared. Each experiment was boiled three minutes and the mucilages were allowed to age one week in corked bottles before taking the relative viscosity.

The following results were obtained:

TABLE III.

Variation in heat applied to powdered tragacanth.	Viscosity of mucilage of tragacanth (prepared with heat-treated powdered tragacanth).				
	Descending ball method (no. sec. req. for 1/4" ball to descend 66" column of mucilage).	Average.	MacMichael viscosimeter.	Average.	
Dried over CaCl ₂ at room temp.	44, 54, 89, 67	63	90, 102, 134, 93	105	
No heat applied	330, 376, 318, 309	333	203, 217, 212, 190	205	
45° C. for 2 hrs.	286, 298, 329, 293	301	200, 180, 197	192	
45° C. for 8 hrs.	293, 281, 278, 326	294	182, 208, 190	193	
80° C. for 2 hrs.	87, 122, 112, 100	105	144, 137, 138	140	
80° C. for 8 hrs.	44, 51, 40	45	88, 81, 96	88	
100° C. for 2 hrs.	43, 52, 56	50	101, 85, 84	90	
100° C. for 8 hrs.	28, 27, 25	27	57, 70, 77	68	

The above results show a tremendous loss in viscosity of the mucilage prepared with powdered tragacanth which has been heated at 80° and 100° C., and a very slight loss at 45° C. Comparing the samples of mucilage with powdered tragacanth (not heated) with mucilage made with powdered gum (heated at 80° C. for 2 hours), a drop in viscosity from 333 to 91 is recorded, which presents such a great difference that the effect of heat on powdered tragacanth is unmistakable.

There does not seem to be any possibility of avoiding the heat developed in milling the gum, although it would be advisable to powder but a small amount of the tragacanth at a time, thoroughly mix and submit a sample to a definite standardized test, such as described in this paper.

Evers and MacLachlan call attention to the advisability of storing the powdered gum in the presence of moist atmosphere. In their investigation they found that deterioration of the tragacanth takes place upon loss of moisture of the pow-

dered gum. In our experiments we found that the powdered tragacanth, dried over calcium chloride at room temperature, produced a mucilage which showed a decrease in viscosity from 333 (tragacanth containing moisture) to 63. This enormous decrease in viscosity makes it imperative that powdered tragacanth should be stored with provision to avoid loss of moisture.

In attempting to arrive at the cause of the above changes which take place in tragacanth when it is subjected to heat, we found the following interesting facts:

TABLE IV.

Powdered tragacanth samples.	Moisture content (dried over CaCl ₂ for 6 weeks), %.	Total volatile matter (100° C. for 2 days), %.	% Acid (as acetic acid) in samples dried over CaCl ₂ .	% Acid (as acetic acid) dried at 100° C.	% Acid (as acetic acid) in normal powdered tragacanth.
1.	8.0	13.0	1.16	1.60	0.65
2.	10.8	13.3	1.24	1.63	0.79
3.	8.9	13.8	1.33	1.60	0.60
4.	12.8	14.0	1.10	1.40	0.70
5.	8.8	11.5	1.08	1.52	0.48
6.	13.0	14.9	1.44	1.33	0.60

A development of acidity takes place when tragacanth is deprived of its moisture and a further increase in acidity occurs upon heating the powdered tragacanth at 100° C. This fact not only indicates a physical change, but a chemical change as well, when tragacanth is subjected to heat.

SUMMARY.

1. In the preparation of mucilage of tragacanth, one- and two-minute boiling periods produce an initial maximum viscosity, which increases greatly upon aging.
 2. Mucilage made by subjection to three-minute boiling period produces a mucilage of high viscosity, yet aging does not materially effect a change in viscosity.
 3. Prolonged boiling decreases the viscosity of the mucilage to a great degree.
 4. Heat has a deleterious effect on powdered tragacanth.
 5. Loss of moisture seriously impairs the powdered gum.
 6. A chemical change occurs when powdered tragacanth is subjected to heat.
- The investigation is being continued.

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REMINISCENCES OF EARLY PHARMACY IN BALTIMORE.

DAVID M. R. CULBRETH, M.D.

Fifty years ago when I was graduated from the Maryland College of Pharmacy several of the older reputable druggists of Baltimore, acquainted with my creditable student record, were concerned sufficiently to seek and offer positions in their stores, a fact convincing me even then that college standing, like virtue, has its reward. However, being satisfied with the clerkship already held for a couple of years, at Laroque's, 20 W. Baltimore St. (old number), which granted the privilege of assisting Professor Simon at the College, it was believed best not to make a change until I was considered equal to assuming business on my own account—that which was the ultimate aim for a suitable living revenue.

On entering the institution, autumn of 1877, I found many echoes of that