NEW ASPECTS OF THE EFFECTS OF GELATIN ON FINGERNAILS

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ABSTRACT

Investigations made on the effects of orally administered gelatin reveal that gelatin increases significantly the hardness of fingernails and apparently improves nail defects in normal subjects.

The use of the technique of measuring the hardness of fingernails as a tool for evaluating the effects of gelatin (or other substances) is described.

The data is discussed in terms of a "specific" action of gelatin on fingernails possibly occurring through the metabolism of amino acids inherent in gelatin or the specific dynamic action of gelatin.

INTRODUCTION

In recent years many attempts have been made to determine the effects of gelatin on the condition and structure of fingernails. Tyson (1) reported in 1950 that oral ingestion of 7.0 g. of gelatin per day for three months returned fragile fingernails to practically normal appearance and texture. McGavack (2) obtained a similar finding in three to twelve weeks when gelatin was administered orally at a dosage of 7.5 g. per day. Rosenberg, *et al.* (3) observed improvement in 43 of 50 subjects with brittle nails after three months of ingestion of 7.0 g. of gelatin per day. In earlier studies Rosenberg and Oster (4) noted improvement after three months in 26 of 36 subjects receiving 7.0 g. of gelatin per day. Schwimmer and Mulinos (5), using a dosage of 7.5 g. of gelatin per day, found improvement in 14 of 17 subjects after three months. Derzavis and Mulinos (6), in a series of experiments, evaluated the improvement of fingernails during oral administration of gelatin at different dosages. These investigators used a dose of 1.8 g. per day in one set of experiments and 7.0 g. per day in another. They reported a $2^1/_2$ times improvement in the nails of the test subjects at the lower dosage of gelatin compared to the placebo subjects and 5 times improvement in subjects receiving 7.0 g. of gelatin daily.

In all of these investigations no attempts have been made to determine the minimum gelatin requirements necessary to evoke a response measured

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in the form of an improvement in nails or the minimum time required to obtain an improvement. Moreover, no adequate methods have been developed with which to measure the responses of the fingernail to orally administered gelatin. Observations to date for the most part have been based on either the visual observations of the investigator in terms of nail improvements or the result of conclusions drawn through interrogation of the test subjects.

In view of these facts we became interested in the possibility of correlations which might exist between physical testing procedures and the visual observations noted by many investigators. On a preliminary basis we undertook a study relating hardness of fingernails to intake of gelatin and visually observed changes in the condition of fingernails. This paper presents the methods and results of this investigation in these and related terms.

Method

For this study we selected 15 adults—8 males and 7 females—varying in age from eighteen to fifty years. All test subjects used in these studies were chosen according to the criteria of good physical health, willingness to cooperate, interest, etc.

The subjects selected had an array of nail defects including chipping, peeling, lamination and breaking, but care was taken not to choose subjects with obvious nutritional, endocrinal or fungal disturbances.

No attempt was made to differentiate the subjects as to age, occupation, dietary requirements, etc. It was our intent to conduct this investigation utilizing healthy adults in order to evaluate the intake of gelatin in normal individuals under ordinary circumstances rather than as a therapeutic agent or adjunct. In our opinion randomization of the type specified in our selection of individuals reduced variables which would be manifest in pathogenic conditions and allowed for an investigation utilizing a "cross section" type of approach under everyday conditions. The volunteer test subjects were instructed not to change or modify any of their habits or daily routines during the course of this study, and the use of such things as detergents, soaps, nail polishes, etc. was not prohibited.

After the test subjects were selected they were divided into two groups. Group A consisted of 2 males and 5 females; Group B was comprised of 6 males and 2 females. Group A received gelatin in capsule form and Group B, lactose placebos. Each group was instructed to ingest one capsule (0.67 g.) three times a day. This regimen was followed for a period of five months. The five-month time period for this study was selected because it has been reported that definitive effects of oral ingestion of gelatin could be shown in eight to sixteen weeks (3, 4 and 5).

Just prior to the start of these studies the nails of each subject were

examined, and the type of nail defects observed were recorded. Following this examination samplings of three nails from each individual used in this investigation were taken and subjected to tests to determine the relative degree of hardness of each nail sample. The nail samples were collected on a random basis. In subsequent samplings the same nails were used as for the initial sampling. At intervals of one, two and five months following the start of this investigation—ingestion of supplemental gelatin or placebos —the nails of all subjects were examined and sampled for hardness testing, the same nails being sampled at each time interval as initially. In addition, at the end of five months following initiation of the study all subjects were surveyed with respect to improvements in the condition of their nails which they observed. The data so obtained was later correlated with the observed changes noted by the investigator.

Hardness testing was conducted with the use of a Kentron Micro-Hardness Tester ®* which employs the principle of indentation of a test substance under a fixed weight. The Kentron Micro-Hardness Tester consists of a ridged beam mounted on flexure plates allowing normal rotational movement about only one axis. To the beam is attached an indenter and a test load. The indenter is held in an elevated position by raising the beam with a system of levers held in place by a latch. The indenter is allowed to descend at a selected constant rate of speed by releasing the operating lever. The speed of descent is controlled by a variable speed oil dash pot to which the beam is linked. The indenter will descend until it meets the surface of the specimen and completes the indentation. The indentation is measured with the aid of a standard metallurgical microscope provided with the hardness tester. The microscope is equipped with a filar micrometer eyepiece and the length of the indentation is measured in filar units. Filar units are converted into microns for subsequent calculations of the hardness number or value desired. (1 Filar Unit = 0.1 Microns)

The indenter used in our research was the Knoop Diamond Indenter, which is cut in the shape of a diamond-based pyramid giving a diamond-shaped impression, in which the long diagonal is nearly seven times the length of the short diagonal. The included longitudinal angle, measured from edge to edge, is 172° 30′, and the transverse angle is 130° 00′. Because of the difference in the lengths of the two diagonals, almost all of the elastic recovery of the indentation made with the Knoop Indenter takes place in the transverse direction. Hence, the measurement of the long diagonal together with the computed indenter constant gives a very close approximation of the unrecovered projected area of the indentation in square millimeters. The relationship between the applied load in kilograms and the approximate unrecovered projected area in square milli-

* The Torsion Balance Co., Clifton, N. J.

meters is called the Knoop Hardness Number for the specimen for that applied load.

The Knoop Hardness Number is expressed by the formula

$$KN = \frac{L}{(Ap)} - \frac{L}{(l^2)(Cp)}$$

where

KN = Knoop Hardness Number
L = Load in kilograms applied to the indenter
Ap = Unrecovered projected area in square millimeters
l = Measured length of the long diagonal of the indentation in millimeters
Cp = Constant relating "l" to the unrecovered projected area of the indentation. For an indenter with a longitudinal angle of 172° 30′ and a transverse angle of 130° 00′, $Cp = 7.028 \times 10^{-2}$

Moreover, since the impressions which result from the use of the Knoop Indenter are rhomboidal with the long axis approximately 30 times the depth of impression measurable, indentations can be made on extremely thin sections of specimen. This fact, considered with the observation that round or square indentations cause extreme fracturing on brittle substances, predicated our choice and use of the Knoop Indenter. (A complete description of the Knoop Indenter may be obtained from the Department of Commerce, National Bureau of Standards, Washington, D. C.)

Test loads to be used are determined by trial on the materials being tested so that the length of the indentation falls within an accurately reproducible range. In our experiments loads used were in the range of 4.1 to 7.1 kg.

The total time allowed for the descent of the Knoop Indenter used in our studies (rate of speed) was fixed at 20 seconds. This rate of speed of descent of the indenter was determined by trial of different speeds under selected weight loads until the reduction of the rate no longer affected the average length of the indentations or until the length of the indentation was constant. This method of load application eliminated error due to impact.

Prior to the actual process of indenting the specimen, the nail samples were lightly polished with 3/0 sandpaper. This procedure was employed since the amount of surface preparation necessary to make a microhardness test will vary with the indenter and test load to be used and the hardness of the material to be tested. The amount of polish required was determined by the ability to define the tips of the indentation and to develop the characteristic rhomboidal shape of the indentation.

Thickness of the nail samples was eliminated as a variable in our work because with the indenter and the weight loads used, no fracturing of the test nail specimens or depressions exceeding the thickness of the nail samples occurred. Fracturing of the specimen or the formation of indentations deeper than the thickness of the sample are factors directly related to

thickness and can be avoided only by selection of the correct speed-weight-depth relationship.

In our work the test nails, varying in length from 2—4 mm., were fastened to a steel block with cellophane tape with the long diagonal of the concave surface of the nail parallel to the axis of the indenter used to minimize error due to curvature.

Three Knoop hardness determinations were made on each nail sample, and the average of the three determinations was recorded. The degree of hardness of the initial samples (Knoop Hardness Number) was recorded as the base line value, and all subsequent values obtained were compared on a relative basis to the initial values. An increase or gain in hardness relative to the initial readings was recorded as a positive (+) change and a decrease as negative (−). No change was recorded as zero (−0−) change.

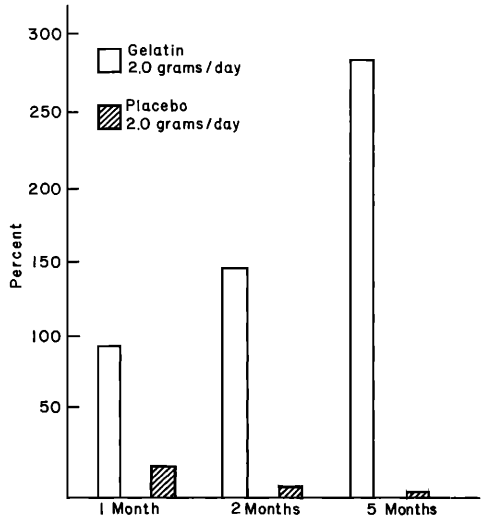

Figure 1.—Average degree of hardness gain.

The per cent change in hardness for each nail sample was calculated at each time interval specified. All data obtained were subjected to statistical evaluation using the chi-square method (7). In all instances the data were computed using a probability factor of 0.01.

Results

The subjects in this investigation were studied through two seasonal periods. In the tabulation of the results, however, no particular variations due to seasonal effects were observed. The data obtained in these studies are given in Tables I and II. Tables III and IV and Fig. 1 set forth the results of the analyses of the data.

TABLE I—AVERAGE CHANGES IN HARDNESS—GELATIN REGIMEN

Subject	Weight Load in Grams	Nail Sample*	Knoop Hardness Numbers Initial	1 Month	2 Months	5 Months
B	4100	R-1	1,344	6,613	9,114	33,563
(Female)		R-3	7,708	7,708	6,613	12,046
		R-5	7,708	4,170	7,708	9,114
J		L-4	3,211	6,810	8,698	14,491
(Male)	7100	R-4	3,211	8,158	10,650	17,253
		R-5	1,752	5,781	6,810	4,310
K		L-3	6,099	12,617	9,273	8,158
(Female)	7100	L-5	5,781	11,452	14,491	8,158
		R-5	631	1,656	1,338	9,926
C	4100	L-5	11,452	5,355	5,732	6,613
(Female)		R-4	3,338	10,918	9,967	7,708
		R-5	5,773	40,340	48,216	6,613
I		L-4	7,668	8,158	14,491	28,925
(Female)	7100	L-5	6,810	3,495	8,158	15,783
		R-5	25,787	11,452	32,568	68,898
M		L-1	414	526	502	572
(Male)	7100	L-3	509	654	666	772
		R-1	3,946	6,099	8,158	9,926
N		R-3	3,088	3,946	7,668	5,214
(Female)	7100	R-4	1,485	2,037	2,971	3,779
		R-5	677	1,241	1,547	1,656

* L-1 = Left Thumb, L-2 = Left Index, L-3 = Left Middle, L-4 = Left Ring, L-5 = Left Little, R-1 = Right Thumb, R-2 = Right Index, R-3 = Right Middle, R-4 = Right Ring and R-5 = Right Little.

TABLE II—AVERAGE CHANGES IN HARDNESS—PLACEBO REGIMEN

Subject	Weight Load in Grams	Nail Sample*	Knoop Hardness Numbers Initial	1 Month	2 Months	5 Months
R	7100	L-4	4,310	8,698	6,810	7,668
(Male)		L-5	3,627	6,810	6,099	4,310
		R-5	2,971	7,221	6,445	5,214
Q	7100	L-5	580	494	509	561
(Male)		R-3	580	631	580	526
		R-5	757	703	703	631
P	7100	L-5	2,037	1,805	1,704	1,525
(Male)		R-3	1,805	2,037	1,805	1,805
		R-5	1,805	1,446	1,610	2,320
O	7100	L-5	6,445	7,221	6,810	5,781
(Male)		R-3	4,210	5,214	4,120	3,495
		R-5	8,158	10,650	6,810	9,273
H	6100	L-5	1,464	1,464	1,384	1,750
(Male)		R-3	1,066	970	965	926
		R-5	926	1,017	1,058	778
E	4100	L-4	2,007	2,182	2,009	1,854
(Female)		L-5	2,092	2,379	2,279	2,092
		R-5	1,253	1,108	1,141	1,141
D	4100	L-4	1,254	1,254	1,176	1,176
(Female)		L-5	1,254	1,538	1,176	1,214
		R-5	1,254	1,254	1,214	1,254
L	7100	L-3	25,539	15,783	15,783	20,860
(Male)		L-5	3,088	3,341	3,088	3,475
		R-5	68,898	68,898	49,466	58,121

* L-1 = Left Thumb, L-2 = Left Index, L-3 = Left Middle, L-4 = Left Ring, L-5 = Left Little, R-1 = Right Thumb, R-2 = Right Index, R-3 = Right Middle, R-4 = Right Ring and R-5 = Right Little.

TABLE III—ANALYSIS OF THE EFFECT OF GELATIN ON FINGERNAILS

Subject	Nail Sample*	% Change in Hardness† 1 Month	2 Months	5 Months	Observed Improvement (5 Months)	Subject's Expression of Improvement (5 Months)
B	R-1	+392	+578	+2397	Absence of peeling	Increased resistance to splitting and peeling. Nails seem stronger
(Female)	R-3	−0−	−14	+56		
	R-5	−45	−0−	+18		
J	L-4	+112	+170	+351	Absence of chipping and breaking	Increased resistance to chipping and breaking. Nails seem stronger and more lustrous, grow faster
(Male)	R-4	+154	+231	+437		
	R-5	+229	+288	+163		
K	L-3	+106	+52	+33	Absence of peeling and chipping. Nails thicker	Increased resistance to chipping and peeling. Nails seem harder and grow faster
(Female)	L-5	+98	+150	+41		
	R-5	+162	+112	+1472		
C	L-5	−53	−49	−42	None	Increased resistance to chipping
(Female)	R-4	+227	+198	+130		
	R-5	+598	+735	+14		
I	L-4	+6	+88	+277	Reduction in splitting	Nails feel harder and show less splitting
(Female)	L-5	−48	+19	+131		
	R-5	−55	+26	+167		
M	L-1	+26	+21	+39	Reduction in chipping. Increased luster	Increased resistance to chipping; nails feel harder and grow faster
(Male)	L-3	+28	+30	+51		
	R-1	+54	+106	+151		
N	R-3	+27	+148	+68	Reduction in peeling	Increased resistance to peeling and breaking. Nails feel harder and grow faster
(Female)	R-4	+37	+100	+154		
	R-5	+83	+128	+144		

* L-1 = Left Thumb, L-2 = Left Index, L-3 = Left Middle, L-4 = Left Ring, L-5 = Left Little, R-1 = Right Thumb, R-2 = Right Index, R-3 = Right Middle, R-4 = Right Ring and R-5 = Right Little.

† (+) = Increase in Hardness, (−) = Decrease in Hardness, and (0) = No Change in Hardness.

In calculating the per cent change in hardness, expressed in Tables III and IV, all data were subjected to statistical evaluation using the chi-square method (7). A chi-square test is applicable whenever one or more differences are compared with expectation based upon a hypothesis. We started with the negative hypothesis that there would be no change in hardness between those nails subjected to placebos and those subjected to the gelatin. A significant value of chi-square denotes a sample so discrepant as to bring into doubt the hypothesis set up; any chi-square beyond 6.635 (a probability value of 0.01) is *large* and suggests rejection of the hypothesis. The larger the value of chi-square, the stronger the evidence against the hypothesis.

In the data in Tables III and IV, the per cent change was recorded when the chi-square value was 6.635 or greater, and therefore considered significant; the values were recorded as no change (0) when the chi-square value was less than 6.635.

Tables I and II present the changes in hardness, expressed as Knoop Hardness Numbers, for the nails of subjects on the gelatin regimen and the placebo regimen, respectively. Each value shown is the average of three measurements made on a single nail sample.

In Table III is recorded an analysis of the data obtained with subject individuals on the gelatin regimen. Examination of the data in Table I reveals several significant observations. First, in all of the test subjects there was a significant increase in the hardness of the fingernail during the course of the study. Moreover, as indicated in Table III this increase can be seen to occur in five of the seven test subjects within a period of one month following initiation of the gelatin regimen. At the end of two months all of the subjects showed a significant increase in the hardness of their fingernails. However, at the end of five months Subjects K and C showed a softening effect. When surveyed both subjects stated that during the fourth and fifth months of this study they were "continuing to take the capsules but not as often." Noteworthy, as indicated in Table III, is the variation in the per cent increase in hardness in the nail samples of any one test subject. This is particularly significant in the case of Subject B.

Also of importance is the relatively high degree of correlation of observed improvements in nail condition to the subject's expression of improvement.

Table IV presents the analyzed data obtained with test subjects receiving placebo capsules. Although an initial increase in the hardness of the

TABLE IV—ANALYSIS OF THE EFFECT OF PLACEBO CAPSULES ON FINGERNAILS

Subject	Nail Sample	% Change in Hardness† 1 Month	2 Months	5 Months	Observed Improvement (5 Months)	Subject's Expression of Improvement (5 Months)
R	L-4	+101	+58	+77		
(Male)	L-5	+87	+68	+18	None	No improvement
	R-5	+143	+117	+75		
Q	L-5	−0−	−12	−0−		
(Male)	R-3	−0−	−0−	−0−	None	No improvement
	R-4	−0−	−0−	−16		
P	L-5	−0−	−16	−25		
(Male)	R-3	+12	−0−	−0−	None	No improvement
	R-5	−19	−10	+28		
O	L-5	+12	+5	−10		
(Male)	R-3	+26	−0−	−15	None	Nails seem to grow
	R-5	+30	−16	−13		faster
H	L-5	−0−	−0−	+19		
(Male)	R-3	−9	−9	−13	None	Nails seemed smoother
	R-5	+9	+14	−16		
E	L-4	+8	−0−	−7		
(Female)	L-5	+13	+8	−0−	None	No improvement
	R-5	−11	−8	−8		
D	L-4	−0−	−0−	−0−		
(Female)	L-5	+22	−0−	−0−	None	No improvement
	R-5	−0−	−0−	−0−		
L	L-3	−38	−38	−18		
(Male)	L-5	+8	−0−	+12	None	No improvement
	R-5	−0−	−28	−15		

* L-1 = Left Thumb, L-2 = Left Index, L-3 = Left Middle, L-4 = Left Ring, L-5 = Left Little, R-1 = Right Thumb, R-2 = Right Index, R-3 = Right Middle, R-4 = Right Ring and R-5 = Right Little.

† (+) = Increase in Hardness, (−) = Decrease in Hardness, (O) = No change in Hardness.

fingernails of these subjects was found, it can be noted that the nails of individuals receiving placebos showed a general tendency to soften as the experiment proceeded. Individual variation in the hardening or softening of the nails of any one subject can also be observed from this data. The striking increase of hardness in the nails of Subject R cannot be fully explained within the scope of the present study. However, it is important to note that at the end of five months the nails of Subject R were softer than at the start of this study. Furthermore, no significant visual improvements in the nails of subjects on placebos were found in contrast to the data obtained with subjects ingesting gelatin.

In Fig. 1 data relative to the average degree of hardness gained for each group of subjects are expressed as per cent gain in hardness. This data shows an average gain in hardness of 102% as early as one month following ingestion of 2.0 g. of gelatin per day. With continued ingestion of gelatin the nails of test subjects showed a continued increase in hardness. From Fig. 1 it can be seen that the nails of subjects receiving placebos showed a slight increase in hardness at the end of the first month. However, at the end of two and five months the nails of these subjects showed a decrease in hardness relative to that observed at the end of the first month.

Discussion

Investigators in the past concerned with studies on the effect of gelatin on fingernails have been handicapped by lack of effective methods and techniques with which to make measurements of changes occurring in the nails of test subjects. As a result the beneficial effects of gelatin taken daily have not been observed or explained adequately. The present study suggests that the testing of nails for variations and changes in hardness offers a satisfactory method for observing changes in nails following administration of substances, dietary or otherwise. Moreover, the correlation between changes in hardness and both observed improvements and the subject's expression of improvement is extremely good and lends support to the use of the technique we have developed and described for measuring changes in the hardness of fingernails.

The mechanism by which gelatin increases the hardness of fingernails is not well understood. Our data suggests that gelatin exerts a specific effect rather than a general effect on fingernails, possibly through both metabolic functions involving amino acids and through its specific dynamic action (SDA).

As suggested by Schwimmer and Mulinos (5), gelatin could increase the presumably diminished blood flow at the nail bed through its SDA. The thermogenic effect of SDA has been demonstrated by several investigators through the use of individual amino acids (8). It has been shown that a 5% solution of glycine was more effective than a 5% solution of glucose in

delaying the onset of a lethal hypothermic state and enhancing the rewarming rate in hypothermic dogs (9). This effect has been attributed to the SDA of glycine; and since gelatin contains more than 26% glycine as well as other amino acids with a high SDA, this may explain in part the effect of gelatin. Our data (Table 1) show a variation in the hardness and changes in hardness of the individual nails of any one subject. From the point of view of the use of the fingers, certain fingers being subjected to more use and mechanical pressures than others, peripheral circulation becomes an extremely significant factor, and any effect on peripheral circulation would, in our opinion, exert an influence on the state and condition of fingernails.

The fact that gelatin may be functioning *via* metabolic activities can be demonstrated through the work of Rosenberg, *et al.* (3 and 4), who obtained evidence for nail improvement after administration of gelatin for several weeks, in a time too short for complete growth of nails. Godwin (10), using S^{35} labeled cystine, found the presence of considerable quantities of cystine in the claws of rats within one to two hours following administration. Borsook (11) has shown that, following the ingestion of a single dose (87 g.) of gelatin, there was not only an increase in energy metabolism but also an increase in the excretion of urinary nitrogen, sulfur, and uric acid. Moreover, fingernails have been reported to contain all their amino acids in similar molecular proportion to gelatin except for cystine, of which nails contain approximately 219 times more than gelatin (12). Furthermore, pure cystine, when fed to patients with nail defects, failed to improve their nails (13).

It is well established that an increase in the rate of protein (amino acid) metabolism causes a simultaneous increase in the rate of metabolism in general. Although the basis of this phenomenon is complex it seems probable that a partial explanation can be found in the relationship between amino acids and the reactions of the tricarboxylic acid cycle. For example, flooding the liver with a mixture of amino acids causes a marked increase in the amounts of pyruvic, oxaloacetic, and alpha-ketoglutaric acids (*via* deamination and oxidation mechanisms) which, through mass action, tend to increase the rate of cycle oxidations. Since high energy ATP is needed for the synthesis of proteins from amino acids, there is an increased demand for ATP for tissue protein synthesis under these conditions, and this demand could be met by an increased rate of ATP formation in the speeded up tricarboxylic reactions. Thus, the ingestion of gelatin (high amino acid concentration) would result in increased ATP formation and subsequent protein synthesis.

Similarly, the ingestion of lactose, which gives rise to glucose and galactose, could increase cycle oxidations, thus accounting for the initial increase in the hardness of the fingernails of test subjects on the placebo

regimen at the end of one month through utilization of body amino acids for this purpose. However, the continuing effect of gelatin in producing an increase in the hardness of fingernails, when compared to the observed effect of lactose, could be explained through the fact that gelatin is providing amino acids of a specific nature, thus suggesting a function of gelatin other than a general source of amino acids.

The rapid rate of response to gelatin observed in our work, one month of gelatin regimen resulting in a significant increase in the hardness of most all of the nails in five out of seven subjects, again supports the concept of a specific effect of gelatin despite the fact that in all probability all the amino acids contained in gelatin are ingested in ordinary daily diets. This is particularly significant in view of the dose administered, 2.0 g. per day. Additional studies using even lower doses of gelatin would shed light on this specific effect of gelatin. It is also interesting to note that with continued intake of 2.0 g. of gelatin there is a continuation of gelatin's effect on the hardness of nails. The data suggests that this effect is specific and constant. With continued gelatin administration the net gain in hardness increases monthly. The significance of this observation is not evident at this time. Only further studies on a time-dosage basis would establish whether this increase in hardness would continue in a linear fashion or would plateau to a constant value in terms of hardness related to the dosage being administered.

Summary and Conclusions

Data has been accumulated which indicates that the daily ingestion of 2.0 g. of gelatin increases significantly the hardness of fingernails and apparently improves nail defects in normal subjects.

Observations made show that the response of the fingernail to gelatin, as measured by changes in hardness, occurs within one month following ingestion of gelatin on a daily basis in five out of seven test subjects. A slight increase in the hardness of the nails of subjects on the placebo capsule regimen was observed, although no improvement in apparent nail defects was obtained.

The use of the technique of measuring the hardness of fingernails as a tool for evaluating the effects of gelatin (or other substances) is discussed.

The results are discussed in terms of a "specific" action of gelatin with the effect of gelatin on fingernails occurring through either specific dynamic action or metabolism of the amino acids inherent in gelatin.

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References

(1) T. T. Tyson, *Invest. Dermatol.*, **14,** 323 (1950).
(2) T. H. McGavack, *Antibiotic Med. & Clin. Therapy*. **7,** IV (1957).
(3) S. Rosenberg, K. Oster, A. Kallos, and W. Burrough, *A.M.A. Arch. Dermatol.*, **76,** 330 (1957).
(4) S. Rosenberg and K. Oster, *Conn. State Med. J.*, **19,** 171 (1957).
(5) M. Schwimmer and M. G. Mulinos, *Antibiotic Med. & Clin. Therapy*, **4,** 403 (1957).
(6) J. L. Derzavis and M. G. Mulinos, *Med. Ann. Dist. Columbia*, **3,** XXX (1961).
(7) G. W. Snedecor, *Statistical Methods*, Iowa State College Press (1950).
(8) D. Rapport and H. H. Beard, *J. Biol. Chem.*, **73,** 299 (1927).
(9) W. R. Beavers and B. G. Covino, *Proc. Soc. Exptl. Biol. Med.*, **92,** 319 (1956).
(10) K. O. Godwin, *J. Nutrition*, **69,** 121 (1959).
(11) H. Borsook, *Biol. Revs. Cambridge Phil. Soc.*, **11,** 147 (1936).
(12) R. M. Block, *Ann. N. Y. Acad. Sci.*, **53** (1951).
(13) Castello v. Pardo, *Arch. Dermatol. and Syphilol.*, **70,** 182 (1954).