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Firmness Of Candy Licorice

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FIRMNESS OF CANDY LICORICE

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SUMMARY

The firmness of candy licorice samples was evaluated by a simple compression test in which the deformation for a force of 500 g was measured. Preliminary results show that differences can be measured by this method and that it may have potential in quality control applications. It also provides a simple rapid means of examining rheological characteristics. Further investigation is required to establish the effect of sample dimensions on the measurement.

1.0 INTRODUCTION

The deformation of foods under applied force is a simple measurement that can be used to evaluate firmness. The method is becoming increasingly popular, and a number of instruments have been developed for the purpose (see references section 5).

The purpose of the preliminary work reported here was to evaluate the deformation test as a method of measuring the firmness of candy licorice samples.

2.0 EXPERIMENTAL METHODS

2.1 Test samples

Eight samples of commercially manufactured licorice were collected. Three were of recent manufacture (i.e. fresh) and 5 had been stored for about 1 year (i.e. stale). The samples are identified in Table 1.

2.2 Test methods

The average axial length of the licorice cylinders was determined using calipers. The average cross sectional area of the cylinders was determined by making an imprint from 10 cylinders on paper. The imprints were cut out and weighed and the area derived. The cross sections were only approximately circular (Fig. 1).

The samples were compressed along their axes between flat surfaces in an Instron Testing Machine (Model TM-M). A recorder with a full-scale response time of 0.2 sec was used to record force Vs deformation. Preliminary tests were made to ensure that this response time was not exceeded at any of the compression speeds used. The minimum time was about 1 sec so it was presummed that the records were not attenuated by recorder response.

Five pieces of each licorice sample were compressed at 0.5 cm/min. This was then repeated at 7 other speeds ranging up to 25 cm/min. To provide a high degree of resolution to the deformation axis (i.e. time) (3) of the strip chart, high chart speeds, relative to the compression rate, were used as follows:

Compression Speed cm/min	Chart Speed in/sec
0.5	0.133
1.0	1.0
2.0	1.0
2.5	2.0
5.0	4.0
10.0	8.0
20.0	8.0
25.0	8.0

Deformation was derived as follows:

$$\text{Deformation} = \frac{(\text{Compression speed cm/min})\ (\text{length of chart in})}{60\ (\text{Chart speed in/sec})}$$

The load controls of the test machine were arranged to automatically stop deformation when the force applied was 500 g. The deformation caused by this load was measured from the charts assuming that zero deformation coincided with the point where the force started to increase from zero.

3.0 RESULTS AND DISCUSSION

A typical record (Fig. 2) shows how the relationship between force and deformation was non-linear. This was true at all the test speeds. It was assumed that this was partly caused by non uniform contact between the compression surfaces and the ends of the specimen at the start of the test and finally by relaxation of the licorice.

The results (Table 2) showed that the area of the samples ranged from 0.68 to 1.52 cm^2, and the length from 2.0 to 3.2 cm. There were marked differences in deformation between samples. Plots of these data (Fig. 3 and 4) showed that the deformation decreased as compression rate increased indicating the effect of relaxation on the readings. In some cases (Samples 2, 5 and 6) there was a trend for the deformation to increase at the maximum speeds. However, the maximum effect of compression speed was evident in the 0 to 5 cm/min range. These results show that the simple technique could be used to study rheological behavior.

To place all the data on a comparable basis, the readings (Table 2) must take into account the differences in area and length of the samples. To a first approximation the deformation should be linearly related to area and length. The data was, therfore, converted to deformation per unit area per unit length or "sample firmness." The results (Table 3) indciated that sample number one (fresh) was far softer than any of the others. There were differences among the other samples but these were not all consistent with the sample being fresh or stale. Based on the average firmness for the data for all speeds pooled, the samples were ranked as follows. This indicated that one sample did not fall where expected according to condition.

Rank (Firm to soft)	Sample and condition	
1	5	Stale
2	6	Stale
3	8	Stale
4	3	Fresh
5	7	Stale
6	4	Stale
7	2	Fresh
8	1	Fresh

The ratio of the firmness readings at two speeds (Table 3) indicated that this index may also be useful for quality control applications.

4.0 CONCLUSIONS

A simple deformation test provides a means of comparing firmness of licorice candy. The preliminary data reported shows that large differences in firmness (confirmed by sensory judgement) are easily detected. There are problems in applying the test that require investigation. The sample dimension should be constant if possible to eliminate their effect, or the effects thoroughly investigated. The ratio of firmness at two compression speeds may provide an easily obtained index related to the viscoelastic properties.

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Table 1. Licorice samples tested

Sample No.	Condition	Brand
1	fresh	Kouvolan lakritsia Lakritsi Paloja Lakrits Bitar Laadun Meskki
2	fresh	Fazer Lakritsipala Lakritsbit
3	fresh	Panda Lakritsia 7115 Panda Suklaatehas (mixed solid & open)
4	stale	Fazer Lakitsia Lakrits
5	stale	Halva Lakritsia Lakrits
6	stale	Lakritsipaloja Lakritsbitar Suklaatehdas Hellas
7	stale	Kouvolan Lakritsia Lakritsi Paloja Laadun Merkki
8	stale	Kouvolan Lakritsia Lakritsi Paloja Laadun Merkki (mixed solid & open)

Table 2. Summary of results - average deformation (mean of 5 samples in mm) for a 500 g force

Compression speed cm/min	Sample No: 1	2	3	4	5	6	7	8
0.5	4.515	1.116	0.798	0.928	0.423	0.494	1.167	0.845
1.0	3.562	1.351	0.808	0.658	0.502	0.345	1.155	0.623
2.0	3.616	1.191	0.637	0.612	0.516	0.312	1.004	0.625
2.5	3.071	1.178	0.564	0.585	0.476	0.426	0.905	0.640
5.0	3.306	1.109	0.659	0.599	0.341	0.328	0.784	0.596
10.0	2.658	0.856	0.497	0.531	0.359	0.359	0.609	0.458
20.0	1.452	0.937	0.557	0.557	0.505	0.307	0.526	0.427
25.0	2.701	1.093	0.520	0.612	0.534	0.390	0.749	0.481
Cross Sectional Area cm^2	0.679	1.143	0.985	0.839	1.521	1.221	0.976	0.901
Sample length cm	2.98	2.65	2.42	2.36	1.97	1.58	3.01	2.50

Table 3. Comparison of sample firmness ($mm/cm^2/cm$) derived from data in table 2.

Compression speed cm/min	Sample No: 1	2	3	4	5	6	7	8
0.5	2.23	0.37	0.33	0.47	0.14	0.26	0.40	0.38
1.0	1.76	0.45	0.34	0.33	0.17	0.18	0.39	0.28
2.0	1.79	0.39	0.27	0.31	0.17	0.16	0.34	0.28
2.5	1.52	0.39	0.24	0.30	0.16	0.22	0.31	0.28
5.0	1.63	0.37	0.28	0.30	0.11	0.17	0.27	0.26
10.0	1.31	0.28	0.21	0.27	0.12	0.19	0.21	0.20
20.0	0.72	0.31	0.23	0.28	0.17	0.16	0.18	0.19
25.0	1.33	0.36	0.22	0.31	0.18	0.20	0.25	0.21
Average	1.54	0.37	0.27	0.32	0.15	0.19	0.29	0.26
Ratio of readings								
0.5 - 10.0	1.70	1.32	1.57	1.74	1.17	1.37	1.90	1.90
0.5 - 5.0	1.37	1.00	1.18	1.57	1.27	1.53	1.48	1.46

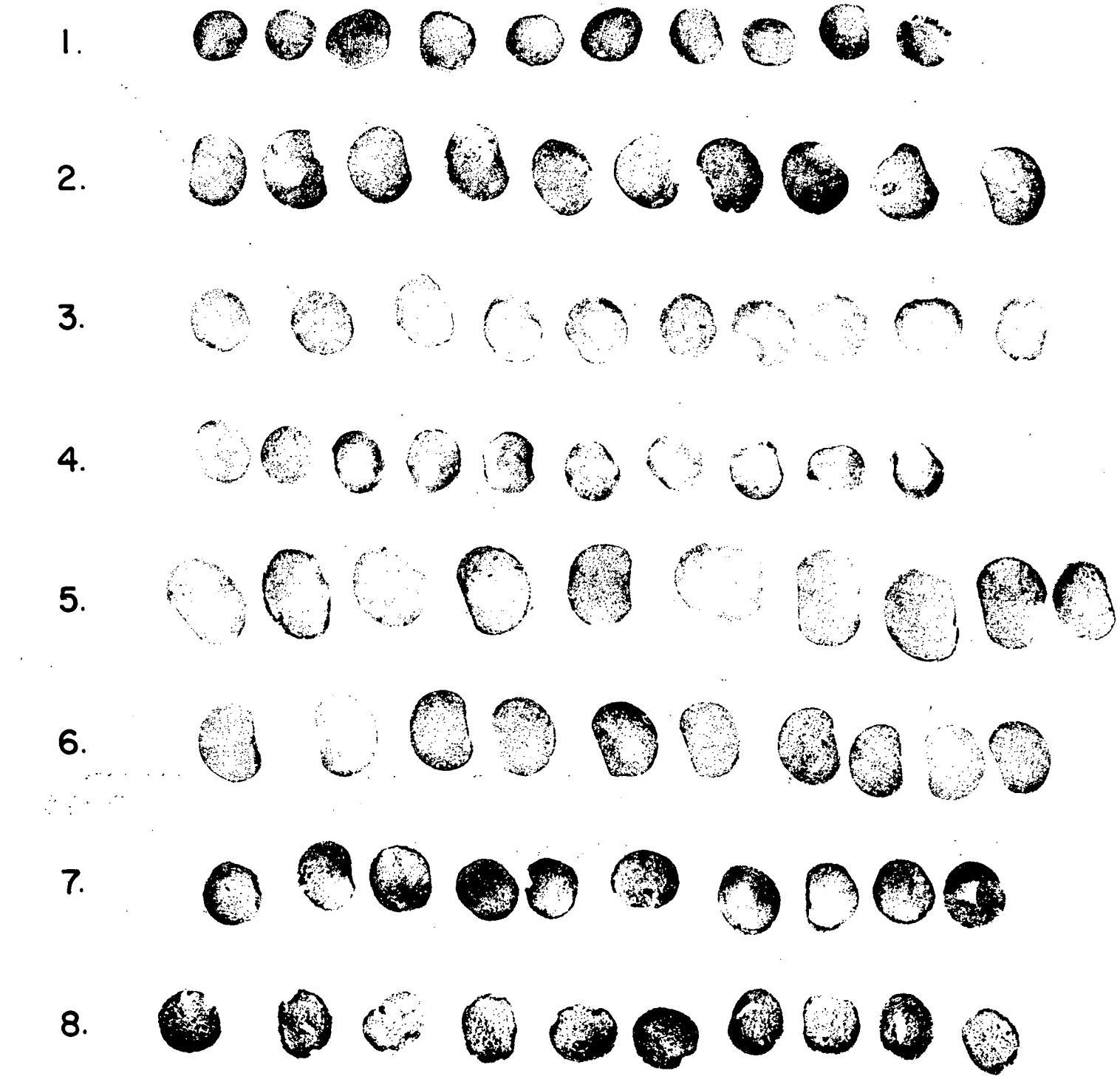

Figure 1. Shapes of cross sections of licorice samples.

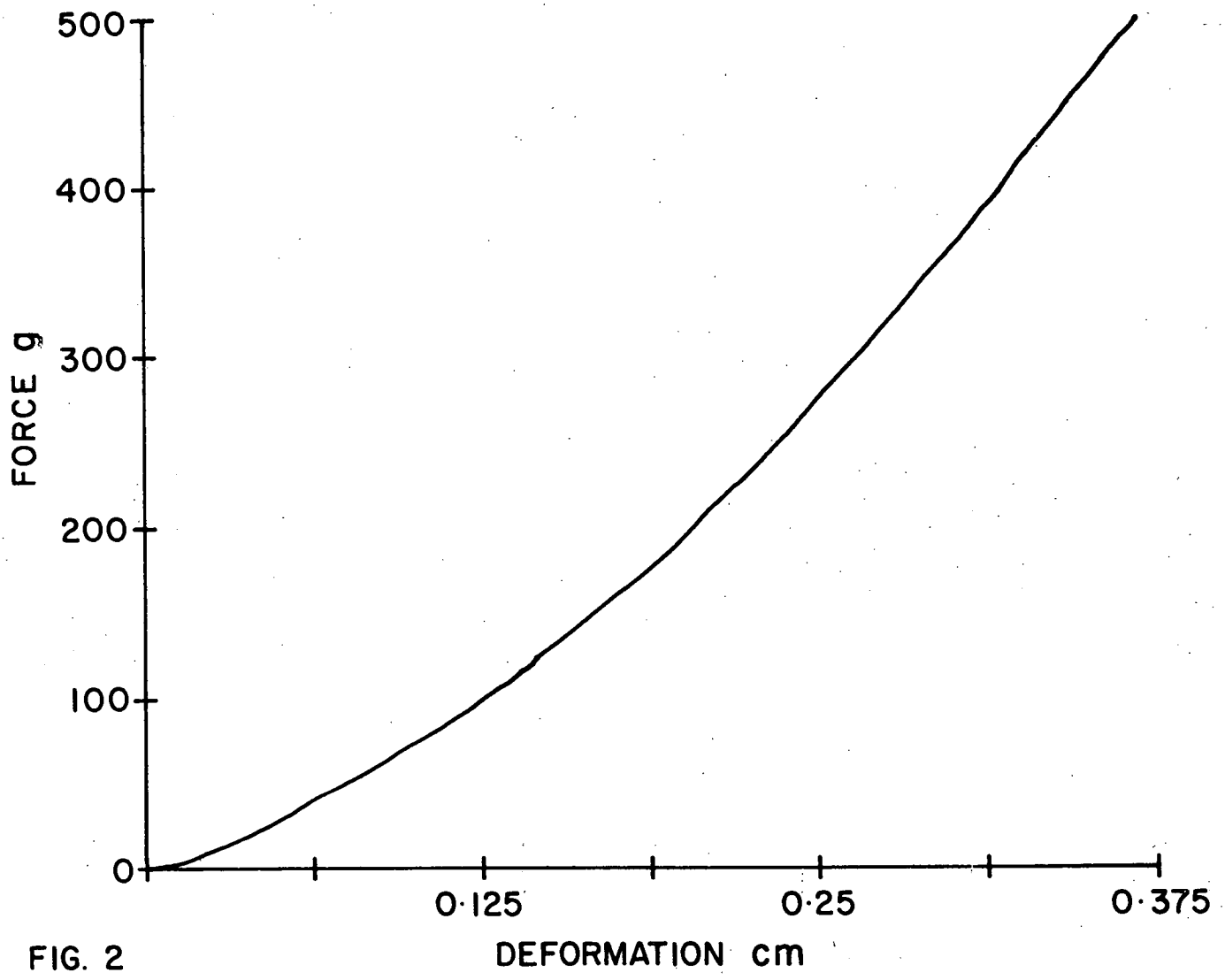

FIG. 2

Figure 2. Typical force-deformation record obtained at a compression speed of 0.5 cm/ min.

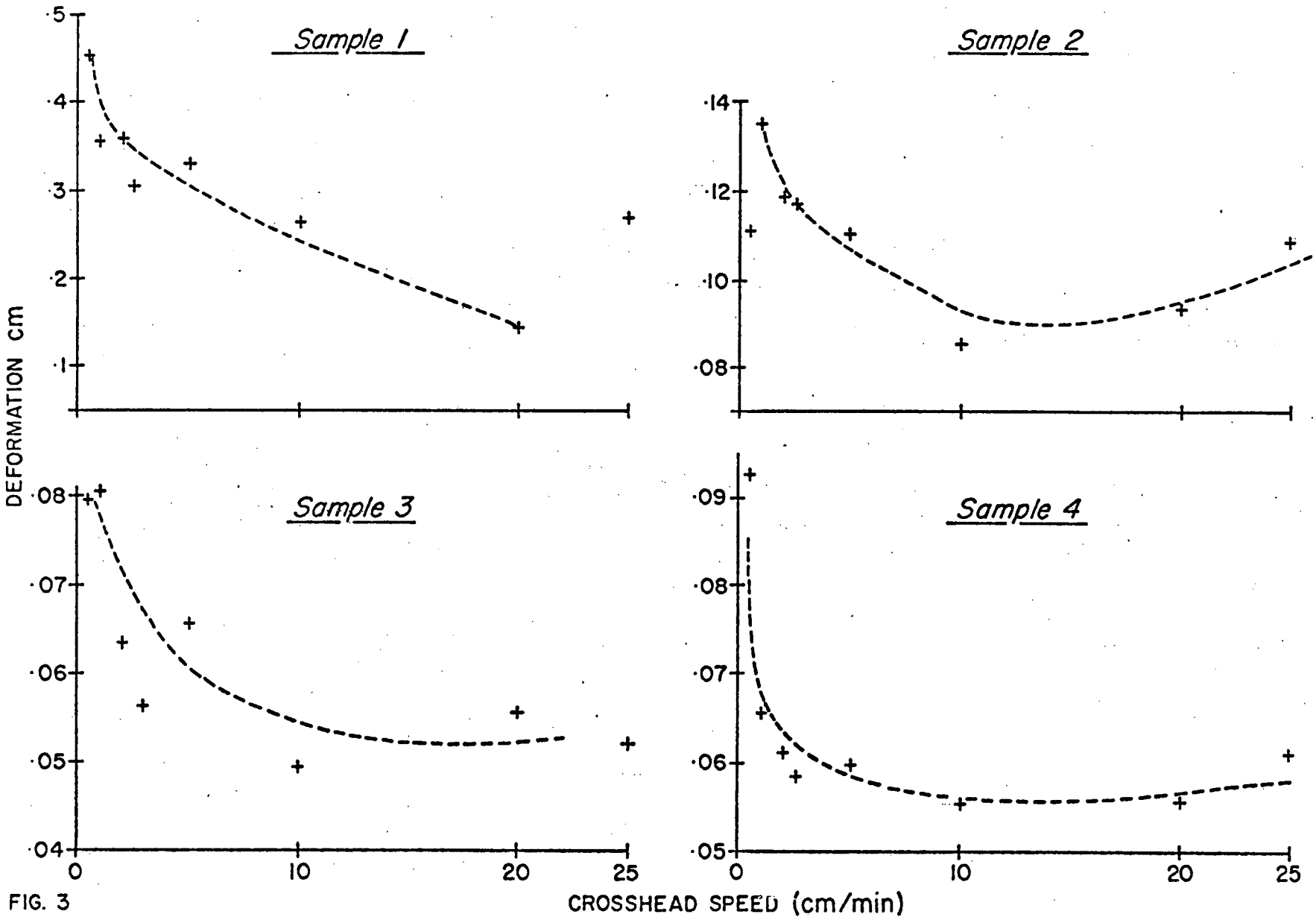

FIG. 3

Plots of deformation Vs compression speed for samples 1 to 4. Each point is the mean of 5 tests.

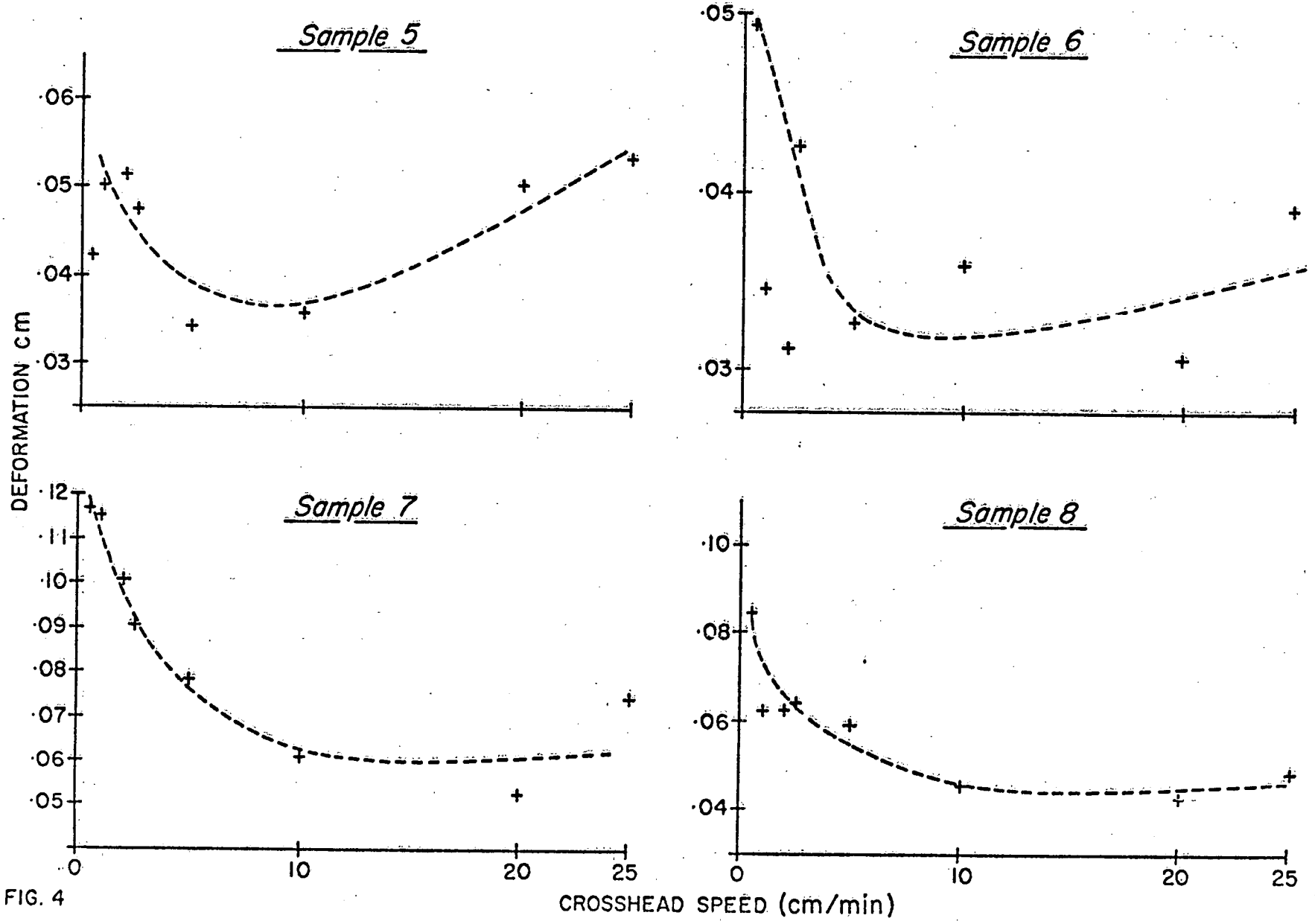

FIG. 4

Plots of deformation Vs compression speed for samples 5 to 8. Each point is the mean of 5 tests.