chemical composition. Perhaps those of smaller molecular size or those with less acidity, and consequently with fewer polar molecules, enter cells more rapidly. If a search could be made for all sorts of polysaccharides from many diverse types of cells, we might be able to find one which would cure not only mice but men.

Years ago, Goerner, basing his experiments on the theory proposed by one of us in 1928 (*2*), was able to show that heparin could destroy the tumor-producing potency of tumor cells *in vitro*. We have tried some experiments on the effect of heparin on rat tumors *in vivo*, but as yet have not had much success. The experiment is complicated by the fact that injection of heparin may produce what physicians call "heparin rebound" (*1*), a state in which the blood becomes more instead of less coagulable.

In line with our theory, there is a possibility that various other substances which prevent blood clotting may prevent cell division and be useful in cancer therapy. Actually, some authors have had success with anticoagulant dyes (*10, 14*). We ourselves have tried the effect of dicumarol on *Chaetopterus* cells and are planning to try it on cancer tissues. The action of dicumarol on *Chaetopterus* egg cells is very striking but somewhat complicated. We will report on it fully in a paper we expect to publish in *Protoplasma*, where we shall also present details of our work with the bacterial polysaccharide.

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Amino Acids in High and Low Protein Corn[1]

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Improvement in nutritive value of plant sources of food both for human and for animal consumption is a challenge to nutritionists and to plant scientists. Progress in research in this field has already led to the use of strains and varieties of plants having superior nutritive value with respect to certain nutrients.

Since the early work of Hopkins (*6*), a number of investigators have shown that there is a definite relationship between protein content and heredity in maize. In spite of these findings, introduction of hybrid corn has generally resulted in production of corn lower in protein content, emphasis being primarily on improved yield per acre. However, high yields and high protein content may not be entirely incompatible if full consideration is given to soil fertility level and density of stand in plants per acre, as well as to heredity.

Corn protein is not of the highest quality, owing to a deficiency of the amino acids lysine and tryptophan in zein, the protein of corn endosperm. The remainder of corn protein is of relatively good quality with respect to its amino acid pattern. The value of corn high in protein content is questionable since much of the increased protein may be in the form of zein, which is characteristically deficient in lysine and tryptophan. Increase in protein content, therefore, may not improve the amino acid pattern, and may even make the total corn protein more unbalanced with respect to the distribution of amino acids.

Doty and associates (*2*) published data which they interpreted as indicating that amino acid distribution in corn protein is heritable. Furthermore, they stated that the physicochemical nature of protein in the grain from two single cross hybrids was distinctly different, as shown by the fact that the sample which contained larger amounts of cystine, arginine, histidine, tryptophan, and tyrosine also contained a larger percentage of alkali-soluble nitrogen and a smaller percentage of alcohol-soluble nitrogen, i.e., the zein fraction.

It follows directly from the heritability of protein that the amounts of amino acids in corn are related to genetic constitution, but it is another question whether or not the amino acid distribution in high protein corn is any different from that in corn of low protein content.

Frey *et al.* (*4*) recently reported on the effects of selection upon protein quality in the corn kernel. In their experiments no improvement was made in the zein-protein ratio in one cycle of selection. These authors stated that the percentage of tryptophan is slightly and positively correlated with the percentage of total protein.

In experiments dealing with the heritability of various nutritive factors in corn, we studied the lysine, tryptophan, and methionine contents of nine different single crosses of inbred lines of yellow dent corn. Individual replicates of these varied in crude protein content from 8.48% to 14.12%.

Each single cross was planted at the same rate in plots two hills wide and ten hills long, each plot being replicated four times in a randomized block. Thus, seasonal, soil, and fertility conditions were uniform, being subjected only to such variation as was imposed by the plot location.

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[2] From Eastern States Farmers' Exchange, Buffalo, New York.

Amino acids present in the corn kernels were determined by microbiological assay (*3*). Average crude protein and amino acid values for the four replicates of each single cross are given in Table 1.

TABLE 1

AVERAGE CRUDE PROTEIN AND AMINO ACID CONTENT OF CORN

Single cross	Crude protein %	Lysine %	Methionine %	Tryptophan %
NY3 × D59	13.02	.37	.18	.13
NY3 × MS19	12.55	.35	.18	.11
NY3 × A206	11.72	.34	.17	.11
D59 × R51	11.20	.35	.18	.09
MS19 × 51A	11.00	.31	.16	.09
A206 × R51	10.13	.30	.14	.09
D50 × 51A	9.80	.31	.15	.09
R51 × B8	8.98	.28	.11	.08
D50 × B8	8.95	.28	.11	.08
Standard deviation (individual replicates)	0.70	.024	.015	.008

These data show that the amounts of each of the amino acids studied varied directly with the crude protein content. Highly significant positive correlations for amino acid content and crude protein were obtained as follows: tryptophan, .87; lysine, .85; and methionine, .83. Thus, approximately 70% of the variation in amino acid content may be attributed to regression on protein. The data indicate the same distribution of the amino acids under consideration, in both low and high protein corn.

In view of these results, and since Doty *et al.* included tryptophan in their studies, the correlation for tryptophan and protein was computed from their data. With late yellow single crosses and with miscellaneous single crosses, highly significant positive correlations of .42 and .59 were obtained, but with midseason single crosses the positive correlation of .15 was not significant. These correlations are of a lower order than those already given, and account for much less of the variation in tryptophan values as being due to regression on protein. These results could be interpreted as indicating a change in tryptophan distribution in relation to total protein content. However, the high correlations which we obtained are positive evidence that the amino acid content in these crosses varied directly with the protein.

In our study, most of the variation in amino acid content is accounted for by regression on protein. The only other known sources of variation would be those attributed to plot differences and to experimental error involved in amino acid assay and crude protein estimation. A certain amount of variation or error from these sources is inevitable, leaving very little to be accounted for by changes in amino acid distribution. Thus, results indicate that amino acid distribution of the three amino acids studied is approximately the same for high and low protein single crosses, and that the quality of the protein was not changed with increases in the amount of protein within the range from 8.48% to 14.12%. These findings are in keeping with the viewpoint expressed by Gortner (*5*) that a given organism reproduces the same structural configuration in those proteins which characterize that organism. But there is no positive assurance that the same relationships hold with corn of protein content above 14.12%. In the authors' opinion, however, little economic significance can be given to the production of corn with protein content much above 14%–15%.

Recently, Dobbins *et al.* (*1*) reported experiments with rats and with pigs fed rations in which the same fractional amounts of the total protein were supplied either by low or by high protein corn, the remainder of the dietary protein being provided from other supplementary sources. Under the conditions of these experiments it is apparent that there was little if any difference in the value of the protein from either high or low protein corn.

It might be expected, however, that high protein corn would be especially valuable for ruminants, since the pattern of the dietary amino acids required by these animals is less exacting than that required by monogastric animals such as swine. However, when rations containing high protein corn are fed to swine, smaller amounts of expensive protein supplements might be needed, especially if the newly discovered animal protein factor is included in the diet.

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