

ble in saturated salt solutions under all the conditions of our tests, we were led to repeat Vines's experiments, but have been unable to confirm his observations, the aleurone grains appearing to be wholly unaffected by saturated salt solution after treatment of the seed with alcohol.

THE PROTEIDS OF THE COW PEA.¹

(*Vigna Catjang*.)

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THE proteids of this plant have never been, to our knowledge, the subject of study. Because of its great and increasing agricultural importance, and as a plant differing botanically from those included in our investigation of "legumin," the proteids of its seeds have much interest. The material examined was prepared by coarsely grinding the peas, separating the black seedcoats by a current of air, and then grinding the coarse meal to a fine flour. Two kilograms of this flour were treated with a quantity of ten per cent. sodium chloride solution, the extract was strained through fine bolting-cloth and allowed for three hours to deposit the greater part of the suspended starch. The extract was then run through a DeLaval centrifugal separator, whereby most of the remaining suspended starch and fiber was removed, and lastly was filtered perfectly clear by passing through a thick layer of filter paper pulp. The extract was saturated with ammonium sulphate, the precipitated proteids collected on a filter and dissolved in brine. The solution was filtered perfectly clear and dialyzed for four days.

The proteid, thus separated in the form of spheroids, was designated *A*, and the solution filtered therefrom was marked *B*. *A* was collected on several paper filters. One portion was washed very thoroughly with water and with alcohol and, dried over sulphuric acid, gave preparation 1, which weighed 29.7 grams. The rest of *A* was dissolved in one liter of five per cent. sodium chloride brine, and the solution filtered perfectly clear. On adding one liter of distilled water a large precipitate, *D*, separated, which was allowed to settle over night. The liquid, *C*,

¹ From the Report of the Connecticut Agricultural Experiment Station for 1896.

was then decanted from the proteid, *D*, which had formed a coherent deposit. *D* was dissolved in 150 cc. of ten per cent. sodium chloride brine, with which it readily yielded a clear solution, and water was added to make the volume one liter. A rapidly settling precipitate appeared that soon united to a coherent layer, from which the nearly clear liquid was decanted. After thoroughly washing this precipitate with water and with alcohol and drying it over sulphuric acid, there resulted 50.9 grams of preparation 2. The solution decanted from 2 was treated with 200 cc. of water, causing a precipitate which, washed and dried as before, gave 12.83 grams of preparation 3. Similarly the solution decanted from 3, when mixed with 200 cc. more water, gave six and two-tenths grams of preparation 4.

The solution decanted from 4 was dialyzed until chlorides were removed, which treatment precipitated all but a trace of the dissolved proteids. In this way four and four-tenths grams of preparation 5 were obtained.

The solution *C*, decanted from the precipitate *D*, as described on page 494, was diluted with 500 cc. of water. The proteid thus thrown down, after washing and drying, formed preparation 6, which weighed 16.9 grams. The filtrate from 6 was dialyzed for two days, and a deposit obtained weighing, when dry, 10.5 grams, 7. The filtrate from 7 was nearly free from proteid matter.

These preparations were analyzed, after drying at 110°, with the following results:

	1.	2.	3.	4.	5.	6.	7.
Carbon.....	52.45	52.69	52.63	52.56	52.52	52.59	52.27
Hydrogen...	6.92	6.77	6.90	6.98	7.04	7.08	6.97
Nitrogen....	17.16	17.18	17.50	17.18	17.27	17.24	16.69
Sulphur.....	0.40	0.57	0.52	0.62	0.53	0.56	0.50
Oxygen.....	23.07	22.77	22.45	22.66	22.64	22.53	23.57
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	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Ash.....	0.32	0.64	0.47	0.50	0.42	0.45	0.16

It will be noticed that the first six preparations are nearly identical in composition. Of these, 1 represents the globulin precipitated by dialyzing the solution of the ammonium sulphate precipitate (which contained all the proteid matter extracted from the seed). 2, 3, 4, and 5 are four fractions of that portion of the substance (of which 1 is a part) that is most readily precipitated by dilution. 6, which also agrees with the foregoing,

is that part of the remainder thrown down by further dilution, the solution filtered from the precipitate, yielding 2, 3, 4 and 5. In composition, 7 differs from 1-6. Although the figures obtained for 1 closely agree with those for 2, 3, 4, and 5, the former has been shown to contain about ten per cent. of the globulin, 7, whose presence in this proportion affects but slightly the percentage composition of 1.

Remarking that 7 agrees in composition with the globulin phaseolin and that preparations 1-6 have a composition corresponding to a mixture of equal parts of phaseolin and legumin, we thought it important to determine whether or not this substance contained these two proteids. Phaseolin being much more readily soluble in dilute saline solutions than legumin, these globulins may be separated by fractional precipitation. Accordingly, twenty grams of 2 were treated with 500 cc. of five per cent. sodium chloride brine, and the solution was filtered off from the undissolved "albuminate." The filtrate, which measured 378 cc., was diluted with four times its volume of water, to produce a one per cent. brine, in which phaseolin dissolves freely and legumin somewhat sparingly. An abundant precipitate fell which was filtered out, washed, and dried, as usual, and formed preparation 8. The filtrate from 8 was saturated with ammonium sulphate, and the very small precipitate produced was dissolved in water and dialyzed. Only three-tenths gram of globulin was thus obtained, showing that very little of the proteid was soluble in one per cent. salt solution.

The residue which remained undissolved after treating 2 with five per cent. sodium chloride brine, was washed by decantation with salt solution, heated to about 50°, and the filtered washings dialyzed. Preparation 9 was thus precipitated.

The portion of 2 that remained undissolved by this treatment was thoroughly washed with water and alcohol and dried over sulphuric acid, making preparation 10. These were dried at 110° and analyzed with results that follow:

	8.	9.	10.
Carbon.....	52.74	52.70	52.87
Hydrogen.....	6.94	6.97	6.95
Nitrogen.....	17.22	17.21	17.29
Sulphur.....	0.40	0.42	0.49
Oxygen.....	22.70	22.70	22.40
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	100.00	100.00	100.00
Ash.....	0.66	0.73	0.64

It is evident that no fractional separation was accomplished by this treatment, and that the most abundant globulin of the cow pea must be regarded as a distinct proteid, differing from any heretofore described. For this proteid we propose the name *vignin*.

Its composition as represented by an average of the foregoing figures is here stated.

VIGNIN.	
Carbon.....	52.64
Hydrogen.....	6.95
Nitrogen.....	17.25
Sulphur.....	0.50
Oxygen.....	22.66
	100.00

The reactions of vignin are as follows: In cold or warm water, when free from soluble salts, it dissolves to a considerable extent, the solutions resulting being precipitated by adding a very little salt. The precipitate so separated dissolves completely on adding more salt.

It is readily soluble in sodium chloride solutions, containing upwards of five per cent. of salt, from which solutions it is promptly precipitated by dilution. In two and one-half per cent. salt solutions relatively little, and in one per cent. very little, dissolves. It is readily and completely soluble in dilute acids and alkalis in absence of salts. Solutions in very dilute nitric or hydrochloric acid are precipitated by salt or by an excess of these acids. In dilute sulphuric acid it is much less readily soluble than in the acids just named, and is not precipitated by an excess of sulphuric acid and but slightly on adding salt. Solutions in very dilute acetic acid are not precipitated by an excess of this acid but give heavy precipitates on adding sodium chloride. Dissolved in one-half per cent. sodium carbonate solution, the proteid is precipitated by neutralization. The separated proteid at once dissolved on adding salt. Dissolved in ten per cent. sodium chloride brine, this globulin behaves as follows:

By hydrochloric acid it is not precipitated until a relatively considerable quantity of the acid is added. By this acid the globulin is less readily thrown down than legumin but more readily than phaseolin.

The same is true of acetic acid, of which a somewhat large quantity is required to cause a precipitate. Phaseolin is not precipitated at all under these conditions.

By diluting the salt solutions of vignin it is apparently more readily precipitated than legumin, and far more readily than phaseolin.

Saturation of solutions of vignin with sodium chloride or magnesium sulphate gives no precipitate, but saturation with sodium sulphate at 34° causes nearly complete precipitation of the proteid.

Mercuric chloride gives no precipitate, tannic acid and picric acid make heavy precipitates in its solutions.

With Adamkiewics', Millon's, the biuret and xanthoproteic tests the usual proteid reactions are obtained.

Strong solutions of this globulin dissolved in ten per cent. sodium chloride become turbid when heated to 98°, and after continued heating set to a jelly.

Besides vignin the cow pea contains a small quantity of proteid matter represented by preparation 7, which in composition, as well as reactions, agrees very closely with phaseolin. Phaseolin differs from all other plant globulins, which we have thus far observed, in not being precipitated from its solution in ten per cent. sodium chloride brine by a large quantity of acetic acid. In this respect 7 behaves like phaseolin.

The composition of phaseolin as obtained from different seeds is shown by the following statement :

PHASEOLIN.			
	Cow pea.	Kidney bean.	Adzuki bean.
Carbon.....	52.27	52.58	52.56
Hydrogen.....	6.97	6.84	6.97
Nitrogen.....	16.69	16.47	16.45
Sulphur.....	0.50	0.56	0.57
Oxygen.....	23.57	23.55	23.45
	100.00	100.00	100.00

The solution *B*, filtered from *A*, as described on page 494, was saturated with ammonium sulphate and the small precipitate produced was dissolved in a little dilute salt solution, filtered perfectly clear, and dialyzed for two weeks. A precipitate resulted which was filtered out, washed with water and alcohol,

and dried over sulphuric acid. This preparation, 11, weighed three and two-tenths grams. The filtrate from 11 was dialyzed ten days longer, but as nothing separated the solution was dialyzed against alcohol. A small precipitate, 12, appeared, which weighed 3.75 grams.

These preparations, after drying at 110°, were analyzed with the following results :

	11.	12.
Carbon	53.13	53.36
Hydrogen	7.09	7.05
Nitrogen	16.51	16.21
Sulphur	1.09	1.13
Oxygen	22.18	22.25
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	100.00	100.00
Ash	0.65	0.81

It will be noticed that these two preparations agree quite closely in composition. Although 11 was precipitated by dialysis in water and is unquestionably a globulin, while 12 could not be precipitated by even prolonged dialysis, nevertheless it is our opinion that these are one and the same proteid. In a subsequent paper we hope to point out the relations of this globulin to the proteids obtained similarly from other leguminous seeds.

CONCLUSION.

1. The chief proteid of the cow pea is a globulin, much resembling the legumin of the pea and vetch, but essentially different in composition and properties, for which we propose the name *vignin*. Its composition, as found by the average of closely agreeing analyses of nine fractional precipitates, is as follows :

VIGNIN.

Carbon	52.64
Hydrogen	6.95
Nitrogen	17.25
Sulphur	0.50
Oxygen	22.66
	<hr/>
	100.00

2. Besides vignin, the cow pea contains a globulin which has the composition and, so far as could be determined, the properties of phaseolin, which we have found in the kidney bean

(*Phaseolus vulgaris*), and the adzuki bean (*Phaseolus radiatus*).

3. The cow pea contains a third globulin, extremely soluble in very dilute salt solutions, which could be precipitated but partially by dialysis in water and completely only in the coagulated form by dialysis in alcohol. This substance closely resembles, in properties and composition, bodies obtained from several other leguminous seeds. Its composition, as found by analysis of two precipitates, one obtained by dialysis in water and the other by further dialysis in alcohol, is as follows :

Carbon.....	53.25
Hydrogen.....	7.07
Nitrogen.....	16.36
Sulphur.....	1.11
Oxygen.....	22.21
	100.00

ON THE MANUFACTURE OF DYNAMITE.

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UNDER the general term dynamite are included two classes of mixtures. The first of these consists of nitroglycerol, held by an absorbing medium, such as woodpulp or kieselguhr, together with various other bodies used as fillers, the principal one being sodium nitrate; this latter body also adds to the strength of the dynamite when woodpulp is the absorbent used by furnishing oxygen for the combustion. The second class, more properly called gelatin dynamites, consists of nitroglycerol gelatinized by means of nitrated cellulose, much the same substances being present as fillers, but considerable less absorbing material in proportion to the amount of nitroglycerol. It is to the former class of mixtures that this paper relates, although most of it is equally applicable to the latter. Most of the dynamite used in this country is of the first class, as it is less costly and equally serviceable, except in wet holes.

The choosing of a site for a dynamite factory is a matter into which many factors enter. It is much more convenient, cheaper, and safer to have the part of the plant used in making the nitroglycerol on a hillside, as it is then possible to allow that liquid to flow from building to building in pipe lines. Authorities usually hold that the soil should not be sandy on account of the