The Proteids of Wheat (II).

BY

M. O'BRIEN, D.Sc.

A GRAIN of wheat, as is well known, consists of the embryo and the endosperm, together with various integuments derived both from the coats of the ovule and the wall of the ovary. In the modern process of milling, the embryo—or 'germ,' as it is technically termed—is removed before the grain is ground, so that the flour is derived entirely from the endosperm.

Since the results stated in my previous paper¹ on this subject refer exclusively to the proteids of flour, I have endeavoured, on the suggestion of Professor Vines, to complete my investigation of the proteid-chemistry of wheat by a study of the proteids of the 'germ.' The necessary material, consisting of isolated embryos, can be readily obtained in quantity from the millers.

The Proteids of the Germ.

The embryo of wheat is richly stored with typical aleuron-grains, its proteids thus assuming the form most characteristic of nitrogenous reserves in seeds; in this respect it contrasts with the endosperm in which the proteids are stored chiefly as gluten, though they also occur in the form of the somewhat abnormal grains in the aleuron-layer described in my previous

¹ Annals of Botany, Vol. ix. p. 171.

[Annals of Botany, Vol. IX. No. XXXVI. December, 1895.]

paper. No starch is present in the embryo, but there seems to be a small amount of sugar, and much oil.

The aleuron-grains occur in almost all the cells of the embryo, including the scutellum: they are, however, absent from the epithelium of the latter, and are often imperfectly formed in the epidermal cells of the radicle and of the coleorhiza, being destitute of globoids; in the reserve-cells of the scutellum they are smaller than those of the aleuron-layer. The grains have usually one distinct globoid, occasionally two or more; around the globoid is a ring of proteid, the outer layer of which is somewhat less soluble than the rest. The proteid ring stains deeply with iodine, fuchsin, Hoffmann's blue, and other aniline dyes: it rapidly dissolves in dilute potash, less rapidly in a ten per cent. solution of sodium chloride, and is only partially soluble in water. The globoid dissolves instantly in picric acid, but is not attacked by dilute potash, salt solution, or water; it thus differs markedly from the substance which forms the core of the grains in the aleuron-layer of the endosperm.

The separation of the various proteids was performed in extracts made from quantities of 'germ,' as the material may be conveniently termed.

Treated with water, germ yields a slightly alkaline extract, holding proteids in solution and much oil in suspension, and filtering with difficulty. On slowly heating the extract, coagula were obtained at three distinct temperatures, namely, at about 55° C., 75° C., and above 80° C. Since, after coagulation is complete, the liquid still gives the xanthoproteic and Millon's reactions, the presence of a proteose is indicated: the amount of it is but small, and it may be a secondary product.

On saturation with sodium chloride, the watery extract gives a dense precipitate of a proteid which is presumably *myosin*. Since this proteid very rapidly coagulated on standing, it was impossible to collect and re-dissolve it so as to determine its exact coagulating-point. Probably it is about 55° C., because the substances remaining in solution

in the watery extract after saturation with sodium chloride, gave no coagulum below 75°C. , but coagulated (as in the original watery extract) at about 75°C. , and later between 80° and 90°C.

The proteids remaining in solution after saturation with sodium chloride were next examined. The liquid was dialysed for about ten days, with the result that a precipitate was formed within the dialyser, whilst the liquid still held a proteid in solution, which was found to coagulate at about 80°C.

Hence it appears that the watery extract of wheat-germ, in addition to a small quantity of proteose, holds three distinct coagulable proteids in solution, viz. :—

globulins	{	coagulating at 55°C. , probably myosin.		
		„	„	„ 75°C. , „ vitellin.
		not coagulating below 80°C. , „ albumin.		

The results obtained from the watery extract by treatment with sodium chloride were confirmed when magnesium sulphate was used. On complete saturation of the watery extract with magnesium sulphate, a reddish-brown precipitate is obtained which readily redissolves on dilution, forming a yellow-brown liquid. This liquid yields a coagulum at two distinct temperatures, viz. 55° and 75°C. , and therefore contains the two globulins already mentioned. Complete precipitation by MgSO_4 was only effected after standing for several days. The proteid remaining in solution after saturation with MgSO_4 was found to coagulate only above 80°C. : it therefore corresponds to the substance, apparently albumin, obtained by the sodium chloride method.

On treating the watery extract of germ with a stream of carbonic acid gas, a precipitate is produced, indicating the presence of globulins; a considerable time (up to twenty-four hours) was required for the complete precipitation of the globulins. The filtrate, after the removal of the globulins, gave a slight coagulation between 80° and 90°C. , thus indicating albumin as before.

Confirmatory results were obtained from extracts of germ with dilute solution of sodium chloride, the same proteids being determined.

The following table summarises the facts observed, and justifies the suggested chemical determination of the proteids of germ :—

I. Globulins: precipitated by CO_2 from watery solution, and by dialysis from solutions of neutral salts.

(a) *myosin-type*: coagulating at 55°C. ; soluble in dilute solutions of NaCl and MgSO_4 , precipitated by excess.

(b) *vitellin-type*: coagulating at $75^\circ\text{--}78^\circ \text{C.}$; soluble in dilute solution of NaCl , not precipitated by excess; soluble in dilute solution of MgSO_4 , precipitated by excess.

II. Proteose: not coagulated by heat.

III. Albumin: does not coagulate below 80°C. ; soluble in NaCl and MgSO_4 solutions, and not precipitated by excess or by dialysis; not precipitated by CO_2 .

Comparison of the Proteids of the Germ with those of the Endosperm.

As stated in my previous paper, I find the proteids of flour to be as follows:—

I. Globulins:

(a) *myosin-type*: coagulating at about 55°C. ; soluble in dilute NaCl and MgSO_4 , precipitated by excess.

(b) *vitellin-type*: coagulating at $75^\circ\text{--}80^\circ \text{C.}$; soluble in dilute NaCl , not precipitated by excess; soluble in dilute MgSO_4 , precipitated by excess.

II. Proteose: not coagulated by heat.

III. Mother-substance of gluten: only attainable in hydrated form as either

(a) *glian*, by extracting flour with alcohol ($75\text{--}90\%$), or

(b) *gluten*, by treating flour with water.

Thus the proteids of germ and of flour seem to correspond so far as the globulins and proteoses are concerned, but in the remaining proteid-matter they differ widely—the insoluble gluten of the endosperm taking the place of the albumin of the germ. Osborne and Vorhees¹ have, however, described as an albumin from flour, under the name of leucosin, a substance which is apparently the proteid which I have classed as a globulin of the myosin-type. As pointed out in the postscript to my previous paper, these authors admit that it has certain qualities which are exceptional for an albumin, inasmuch as it is precipitated by magnesium sulphate and coagulates at the low temperature of 52° C. But the fact that this proteid was not, in their experiments, precipitated from saline solution by dialysis, led to its classification by them as an albumin. So far, however, as I have been able to investigate the point, I have never found the proteid in question to behave in this way on dialysis; and the further fact that it is completely precipitated by passing a stream of carbonic acid gas through its solution supports the view that it is a globulin rather than an albumin.

Among my dialysis-experiments were the following. (1) A watery extract of flour was saturated with magnesium sulphate; the precipitate formed was redissolved, and its solution submitted to dialysis. After ten days the liquid in the dialyser, when filtered from the precipitated proteid, still contained a minute trace of coagulable proteid. Since, however, it did not show any sign of coagulation below 60° C., but only as boiling-point was approached, it would seem that this coagulable proteid could not be either the myosin-like globulin or Osborne's albumin (leucosin), but was a small residue of the vitellin-globulin. (2) In another case an extract of flour made with 10% sodium chloride solution was, in the same way, saturated with magnesium sulphate, and the resulting precipitate redissolved as before. After the solution had been submitted to dialysis for eleven days in the presence of chloroform, and a dense precipitate had been

¹ Connecticut Agricultural Experiment Station, Annual Report, 1893.

formed, the liquid in the dialyser was filtered. Even after repeated filtration the filtrate remained slightly milky, but when heated no increase in turbidity was perceptible, so that all the proteid in the extract had been precipitated by dialysis. Distilled water was used throughout. The dialysate was changed daily and tested, but there was no indication that any proteid had passed through the dialyser.

In accordance with these facts, the table of the proteids of flour on p. 546 may be amended by the following addition :—

I. Globulins : precipitated by CO_2 , and by dialysis, from neutral saline solutions.

Hence the correspondence between the globulins of germ and those of flour may be regarded as fairly complete.

BOTANICAL LABORATORY,
OXFORD.

O'Brien, M. 1895. "The proteids of wheat (II)." *Annals of botany* 9, 543–548.
<https://doi.org/10.1093/oxfordjournals.aob.a090754>.

View This Item Online: <https://www.biodiversitylibrary.org/item/233478>

DOI: <https://doi.org/10.1093/oxfordjournals.aob.a090754>

Permalink: <https://www.biodiversitylibrary.org/partpdf/318393>

Holding Institution

Smithsonian Libraries

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: Not in copyright. The BHL knows of no copyright restrictions on this item.

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.