

COMMUNICATION TO THE EDITOR

Gelatinization of Starch during Cooking of Spaghetti

TO THE EDITOR:

As part of a study to determine the nature of starch in spaghetti at various stages of processing, an examination was made of the degree of gelatinization of the starch at various stages of cooking. Starch granules were examined under polarized light to determine the ratio of birefringent to nonbirefringent granules as an indication of degree of gelatinization (1).

To obtain an indication of whether protein content and durum variety affected the results, the samples used contained 8 and 17% protein and were made from two varieties, Leeds and Tunisian. These samples had previously been used by Matsuo et al. (2) to study the effect of protein level on cooking quality. Five-gram samples were cooked in 150 ml. of boiling tap water, with a portion of the sample being removed after 5 min. of cooking, and the remainder being cooked to *al dente* as determined by the Braibanti technique (3). In every case the samples were rinsed in cold water immediately after cooking. For control purposes, samples of the uncooked spaghetti were also soaked in water at room temperature for 4 hr., then examined microscopically.

For microscopic examination, samples were pressed between two Plexiglas plates and wet mounts made of a full-width section of the pressed strand. In the case of sample portions cooked 5 min., squeezing them between the plates revealed two or three areas or zones of cooking. Each of these zones was dissected out of the sample and examined separately under the microscope. All samples were examined under polarized light at 10X and 40X magnifications.

Microscopic examination of starch extracted from the control samples revealed almost no loss of birefringence, suggesting that virtually no gelatinization had taken place during soaking. As shown in Fig. 1, samples cooked for 5 min. showed zones of cooking. Unlike the high-protein samples which showed three zones, the low-protein samples showed only two. The outer zone for all samples showed

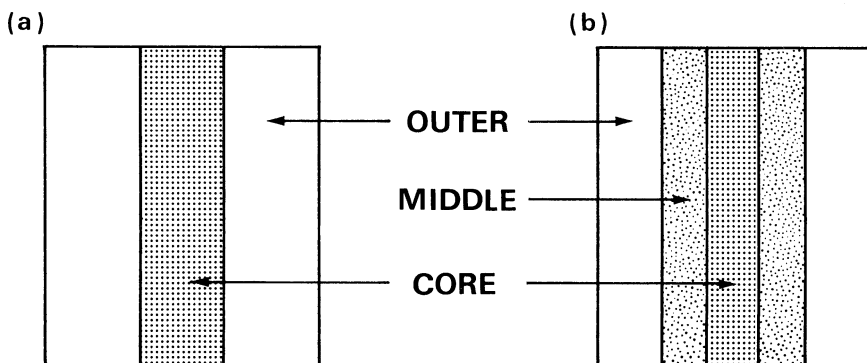


Fig. 1. Zones of cooking visible when the samples are pressed between Plexiglas plates after 5 min. of cooking. a, Low-protein (8%) sample; b, high-protein (17%) sample.

almost total loss of birefringence while the inner core showed very little evidence of gelatinization. The middle zone in the high-protein samples showed intermediate loss of birefringence. After the samples had been cooked to *al dente*, loss of birefringence was almost total and no separate zones of cooking were observed.

These results suggest that gelatinization of starch takes place gradually during cooking of spaghetti. The presence and nature of the zones observed after 5 min. cooking suggest that gelatinization takes place in an inward direction and that water penetration, and hence cooking, is more rapid at lower protein levels. This latter suggestion is supported by the fact that the high-protein sample took 1.5 min. longer to cook than the low-protein sample for pasta made from the Tunisian durum. However, samples made from Leeds required the same amount of cooking time to reach *al dente*, regardless of the protein content. Use of a larger number of samples in future work should help to clarify this particular finding. In addition, it appears that although protein quality and quantity are thought to affect the cooking quality of pasta, the end point in cooking is determined by examination of the starch.

SUSAN MARSHALL

Dept. Plant Science
University of Manitoba
Winnipeg, Manitoba
Canada
R3T 2N1

RON WASIK

Food Research Institute
Ottawa, Ontario
Canada
K1A 0C6

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