EFFECT OF PARBOILING ON THE THIAMINE, RIBOFLAVIN, AND NIACIN CONTENTS OF WHEAT[1]

Z. I. SABRY AND R. I. TANNOUS

ABSTRACT

Samples of the hard wheat, variety Senator Capelli, were parboiled for 0.5-, 1-, 1.5-, 2-, and 3-hour periods. The samples were then dried and crushed, and the bran was removed. The effect of the various heat-treatments on the thiamine, riboflavin, and niacin contents was determined in the crushed parboiled grain as well as in the bran. The longer the parboiling time, the more thiamine was destroyed. While the riboflavin content of wheat was hardly affected by parboiling and subsequent oven-drying, a substantial amount of the vitamin was destroyed when the product was sun-dried. The niacin level tended to increase with the increase in parboiling time. These changes appear to be due to direct heat destruction and the redistribution of the vitamins from the outer layers to the inner layers of the wheat grain.

Parboiled wheat is one of the most important cereal products in the Middle East. It is known as *burghul* in the Arab countries and as *bulgur* in Turkey and Central Europe.

Parboiled wheat is usually prepared on a small scale in the villages. After the wheat is separated from the chaff, it is washed in cold water and boiled in an uncovered copper kettle for 2 to 3 hours. The boiled wheat is spread in the sun to dry and then is usually moistened with a sprinkle of water before it is crushed and the bran removed.

Saracoglu (3), Saracoglu and Babadag (4), and Shammas and Adolph (5) found that thiamine and, to a greater extent, riboflavin decreased considerably during the parboiling process. However, the niacin content of the parboiled product was found to be slightly higher than that of wheat (5).

The present work is an attempt to determine the extent of heat-treatment necessary for the parboiling process and its effect on the level of thiamine, riboflavin, and niacin in the wheat grain as well as in the bran.

Materials and Methods

Preparation of Samples. Seven 1-kg. samples were prepared from the hard wheat, variety Senator Capelli. An unboiled sample served as a control while five samples were boiled for 0.5-, 1-, 1.5-, 2-, and 3-

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hour periods. Water was added in such an amount that all of it was absorbed by the time boiling was checked in order to eliminate leaching of water-soluble nutrients. The amounts of water added per kg. of wheat were 950, 1,600, 2,100, 2,800, and 3,400 ml. for the boiling periods of 0.5, 1, 1.5, 2, and 3 hours, respectively. The boiled samples were spread on trays and dried in a forced-draft dehydrator. The dried samples were sprayed with a little water, then ground in a Wiley mill and left on trays overnight to dry at room temperature. The ground samples were sieved in a forced draft to remove the bran. The seventh sample received a 2-hour boiling treatment and was dried in the sun for 3 days. This was done to study the effect of sun-drying on the riboflavin content of the parboiled product.

Assay Methods. The thiochrome method (1) was used for the determination of thiamine. Riboflavin was determined by the fluorescence method (1). Niacin was assayed by a microbiological technique (1) using *Lactobacillus arabinosus* ATTC 8014[2] as the test organism.

Results and Discussion

All the parboiled samples were rated acceptable with regard to color, texture, taste, and odor. The sample which received the 3-hour boiling treatment was slightly dark in color and showed moderate clumping and stickiness; that with 0.5-hour boiling had less gelatinization than the other samples. The uniformity in the gelatinization of the starch throughout the endosperm was judged by a translucent appearance and absence of opaque spots. The amount of bran separated from the parboiled grain decreased with the increase in boiling time during the first hour. The bran yields corresponding to 0, 0.5, 1, 1.5, 2, and 3 hours of boiling time were 16.5, 15.1, 14.4, 14.1, 14.0, and 14.2%, respectively. This difference in bran yields may be due to the gelatinization of starch in the endosperm during boiling and the trapping of part of the embryo and the scutellum into the parboiled product.

It is evident from the data expressed in Fig. 1 that the heat-treatment has a direct destructive effect on thiamine. The riboflavin content of the wheat grain decreased slightly as a result of the parboiling process, as shown in Fig. 2. However, when the parboiled wheat was dried in the sun, the loss of riboflavin amounted to 76% as compared with 20% loss in a sample receiving the same parboiling treatment but dried in the oven. The parboiling process brought about an increase in the niacin content of bulgur, apparently at the expense of the bran fraction content, as indicated in Fig. 3.

[2] Obtained from the American Type Culture Collection, 2029 M Street N.W., Washington 6, D. C.

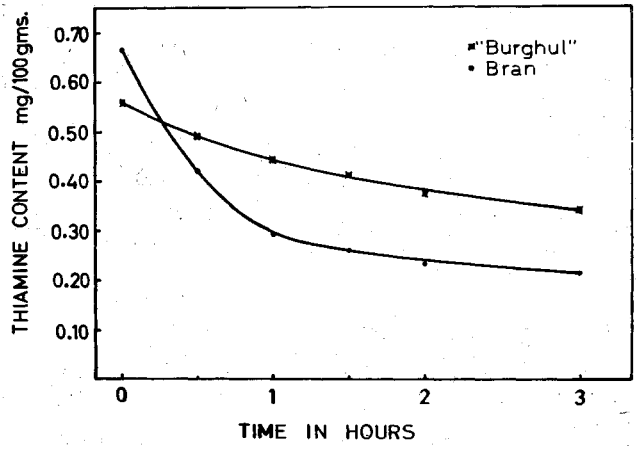

Fig. 1. Effect of parboiling on thiamine content of wheat.

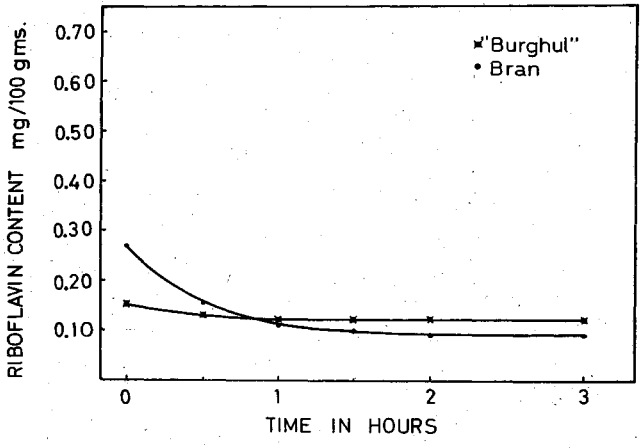

Fig. 2. Effect of parboiling on riboflavin content of wheat.

In all cases, it was found that the thiamine, riboflavin, and niacin levels decrease at a much faster rate in the bran than in the grain. This may be attributed to direct heat destruction as well as to redistribution of these vitamins from the outer layers to the inner layers of the wheat grain. Since the bran is rich in niacin and the germ is the part considered richest in thiamine and riboflavin (2), the vitamin redistribution has a more pronounced effect on the niacin content of the parboiled wheat than on the thiamine and riboflavin contents.

From the foregoing evidence, a parboiling time of 0.5 to 1 hour may be recommended for the making of bulgur. This would result in high-

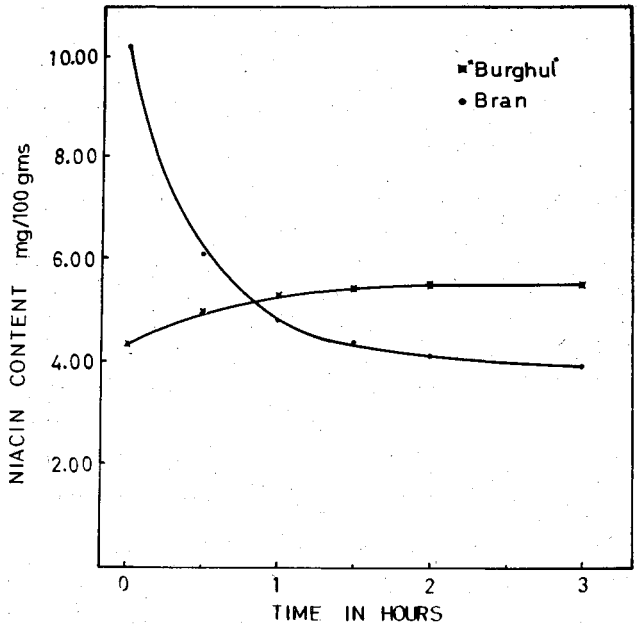

Fig. 3. Effect of parboiling on niacin content of wheat.

er retention of thiamine, while permitting almost the same increase in niacin content as is obtained with the conventional 2- to 3-hour boiling. Oven-drying of the product results in markedly better retention of riboflavin than does sun-drying, but economic considerations preclude oven-drying as a substitute for the preparation of bulgur, as at present, on a family or village basis.

Literature Cited

1. Association of Vitamin Chemists, Inc. Methods of vitamin assay (2nd ed.). Interscience: New York (1951).
2. Jackson, S. H., Doherty, A., and Malone, V. Recovery of the vitamins in the milling of wheat. Cereal Chem. **20:** 551–559 (1943).
3. Saracoglu, S. The thiamine content of Turkish wheats and corresponding bulgurs. Cereal Chem. **30:** 323–327 (1953).
4. Saracoglu, S., and Babadag, T. The vitamin B_2 content of Turkish wheats and its change in the preparation of bulgur. Z. Lebensm. Untersuch. u. -Forsch. **97:** 7–11 (1953); Chem. Abstr. **47:** 10142g (1953).
5. Shammas, E., and Adolph, W. H. Nutritive value of parboiled wheat used in the Near East. J. Am. Dietet. Assoc. **30:** 982–983 (1954).