Effect of Milling on Cooking Time of Sorghum Grain

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ABSTRACT

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Three cultivars of hybrid sorghum grain of the hetero-yellow type were milled in an abrasive mill for varying lengths of time to remove different amounts of the outer layer of grain. The intact grain from each milling time was cooked to a soft, edible stage in water at 98° C. For all cultivars, cooking times decreased as the outer layers were removed, with the greatest decrease from removal of the first 10% of the grain. When about 20% of the grain had been removed, constant cooking times were attained for all cultivars. The minimum cooking times (46–49 min) were substantially longer than that for rice (about 25 min).

Sorghum is an important dietary item in many parts of Africa and Asia, particularly in dry and semi-arid regions because it is more drought resistant than wheat and rice. In a number of countries in Africa and Asia, grain is commonly milled and boiled in water, and the cooked grain is consumed like rice (Hsu and Hsu 1977, Vogel and Graham 1979). Boiled sorghum grain is said to have appearance and taste similar to those of rice (Hutton 1974). Because the price of sorghum is about one-third that of rice, greater use of sorghum as a rice substitute should be feasible. The cooking time for sorghum is much longer than for rice, however, (Badi et al 1978; Viraktamath et al 1971, 1972) and would be a deterrent to such usage. The bran layer has been reported to hinder the absorption of water; hence removal of the outer layers would be expected to reduce the time required to produce a soft, cooked grain (Desikachar 1974). Removal of the bran layer is also desirable to remove the pigments from the grain. The aim of the work reported in this paper was to examine the effect of the removal of outer layers on the cooking time of three cultivars of sorghum.

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MATERIALS AND METHODS

Seed Characteristics

Three cultivars of hybrid sorghum grain of the hetero-yellow type (Dorado, SM8, and F64A) were obtained from the Hermitage Research Station, Warwick, Queensland, Australia, and stored at 20° C to allow a uniform moisture content. Each cultivar was size-graded with a set of sieves; the most common size (3.35–3.99

TABLE I
Description of Sorghum Cultivars

Cultivar	Seed Weight (g/100 grains)	Protein (g/100 g)	Pericarp Color	Pericarp Weight (g/100 g)	Endosperm[a] Texture
Dorado (Asgrow)	3.3	13.7	Red	6.3	1.1
F64A (Dekalb)	3.3	13.5	Red	6.8	1.3
SM8 (Yates)	3.2	12.6	Red	6.3	1.7

[a]Texture rating scale: 1 = 100% corneous endosperm, 5 = 100% floury endosperm.

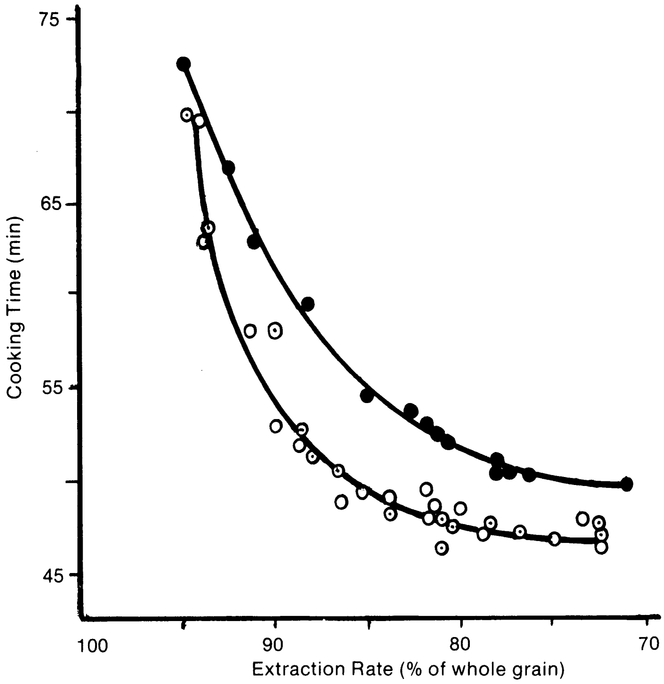

Fig. 1. Effect of abrasive milling on cooking time of three cultivars of sorghum grain. Cultivars: • = Dorado, ⊙ = SM8, o = F64A. Each point is the mean value of three estimations.

mm diameter for all cultivars) was selected for use in the studies. The weight of 100 kernels was obtained. The protein content of the grain was determined by micro-Kjeldahl using method 2.049 (AOAC 1975) and the conversion factor N × 6.25. The pericarp of intact grain that had been soaked in distilled water for 2 hr was removed with a scalpel under a magnifying glass. The pericarp and residue were dried under vacuum and weighed. The texture of the endosperm was estimated visually, using a continuous scale 1–5, in which 1 = 100% corneous, 0% floury and 5 = 0% corneous, 100% floury (Maxson et al 1971). Table I gives the description of the cultivars examined.

Milling and Cooking

Grain was milled in an abrasive mill (Kett Husk Pearler, Kett Electric Co., Japan) for varying lengths of time to remove different amounts of the outer layer of grain. After pearling, the unbroken kernels 2.8–3.34-mm in diameter were collected and weighed, and the percent of intact grain remaining was calculated. The intact grain from each milling time was analyzed for cooking time.

The time for each sample to cook to a soft, edible stage was determined using the method described by Chakrabarthy et al (1972). A sample (2 g) was placed in a test tube with water (25 ml) and cooked at 98° C in a waterbath. Periodically, a few kernels were withdrawn and pressed between glass slides. White chalky spots, indicating the presence of ungelatinized starch (Voisey and Larmond 1973), initially appeared on the glass slides. When the white spots ceased to appear, the grain was considered adequately cooked.

RESULTS AND DISCUSSION

Figure 1 shows that for all varieties, cooking times decreased as the outer layers were removed. The greatest decrease in cooking time occurred from the removal of the first 10% of the grain. When about 20% of the grain had been removed, the cooking time was not reduced by further milling. Milling was not continued beyond 70% extraction because of excessive breakage of the grain. The minimum cooking times of 46 min for F64A and SM8 and 49 min for Dorado were, however, still substantially longer than that for rice (about 25 min).

The initial rapid decrease probably occurred during the removal of the pericarp layer, and the minimum cooking time was probably attained when the corneous endosperm was fully exposed. Thus the structure of the corneous endosperm seems to ultimately determine the longer cooking time of sorghum. If the cooking time of sorghum is to be reduced to an acceptable length similar to that of rice, not only must the pericarp be removed but some simple method must be found to partially disrupt the structure of the corneous endosperm to allow rapid absorption of water.

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