

Distribution of Oil in the Bran Layers of Slender, Medium, and Short Grain Varieties of Rice, and Effect of Parboiling

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ABSTRACT

A study of the distribution of oil in slender (IR-22), medium (Jaya), and short (Bala) grain types of rice indicated that the oil content of the bran was highest in IR-22 (24.4%) followed by Jaya (22.8%) and Bala (15.2%) at a given (5%) polish percentage. Parboiling increased the oil yield of the bran in all the varieties, but much more in Jaya and Bala (7-9%) than in IR-22 (3%) indicating that in the slender IR-22, the oil was more concentrated in the surface layers of the grain. The oil content increased somewhat sharply in IR-22 and Bala up to 4.0 and 5.5% polish, respectively, and then declined with further polish. In Jaya, the increase was smaller and more or less constant up to 6.0% polish. Changes due to parboiling were similar to those for raw samples with higher values for the parboiled samples. Distribution in surface fractions showed highest values for each fraction from the slender IR-22 followed by the medium Jaya and the short grain Bala. The pattern of distribution was, however, strikingly different in the slender variety compared to the others. Difference between raw and parboiled fractions in each variety was not similar: in IR-22, the increase in parboiled samples was 5-7%, 5-13% in Jaya, and as much as 1-11% in Bala.

INTRODUCTION

Solvent extraction plants obtain their supply of bran for oil extraction from different varieties and lots of rice. In view of the supposed relationship existing between bran thickness and fineness or coarseness of varieties (1), a fixed or predetermined polish percentage given to all of slender, medium, or short grain types may leave on the milled rice oil-rich bran in certain types and overmill others. The result is that the bran from the former may yield less oil, and the milled rice may undergo spoilage during storage. In the latter, the bran, because of overmilling, may be contaminated with the inner endosperm starch, and its oil content may be reduced.

Parboiled rice bran is reported to yield higher amounts of oil than raw rice bran (2). This has been variously ascribed to outward migration of oil bodies in the grain due to the heat treatment in parboiling, enrichment of the bran due to less admixture by endosperm starch because of harder grain and less brokens compared to raw rice bran, and better extractability of oil with solvent. The exact reasons or mechanism(s) are yet not clear.

The present paper describes results of experiments on the extent and distribution of oil in the bran layers of high yielding varieties of rice belonging to the slender, medium, and short grain types, and the effect of parboiling on this distribution. It is hoped that the findings would help in screening types suitable for higher oil yields at desirable polish percentages and also indicate the efficiency of parboiling for increasing the oil output.

EXPERIMENTAL PROCEDURES

IR-22, Jaya, and Bala were the three varieties chosen for the study and represented slender, medium, and short grain

types, respectively. They were collected from the "aman" (winter) harvest of 1974. After being cleaned, screened, and shelled, sample lots of brown rice were polished in a McGill Polisher to different degrees up to a maximum of 7.5%. Parboiled samples were prepared by soaking 1 kg samples in water at 70 C for 3.5 hr followed by open steaming for 10 min and shade drying. Both raw and parboiled samples were milled at 13% moisture content. 5-g Samples of bran were used for extraction of oil for the different degrees of polish.

For the study of the distribution of oil in the kernel, 0.5 to 2.0-g samples were used from successively removed bran fractions by tangential abrasive milling in a Satake polisher; up to six surface fractions were obtained. Oil was extracted from all bran samples with n-hexane using Soxhlet extraction procedure.

RESULTS AND DISCUSSION

Oil Content of Bran with Reference to Degree of Polish

The results in Figure 1 indicate that the oil content in the raw rice bran increased somewhat sharply in IR-22 (25.75%) and Bala (15.6%) up to 4.0 and 5.5% polish, respectively, and then dropped with further polish. For the variety Jaya, the increase was relatively smaller, and the curve was more or less flat up to about 6.0% polish with the oil content maintained around 22.4%, suggesting a more or less even distribution of oil in the bran layers. At a given (5%) percentage polish, however, the oil content of the bran was found to be highest in IR-22 (24.4%) followed by Jaya (22.8%) and Bala (15.2%). It would appear that the bran layer is thinner in IR-22 than in Bala and much more so compared to Jaya. Moreover, the oil is concentrated in fewer cell layers in IR-22 and Bala, especially in the former, compared to Jaya.

The changes in parboiled samples were more or less similar to those in raw samples of the different varieties, but parboiling increased the oil yield in all the varieties with much higher values for Jaya and Bala (7-9%) than for IR-22 (3%) (Fig. 1). The difference between the peak values of raw and parboiled bran oil content was much smaller in IR-22 (about 6%) compared to Jaya (about 8%) and Bala

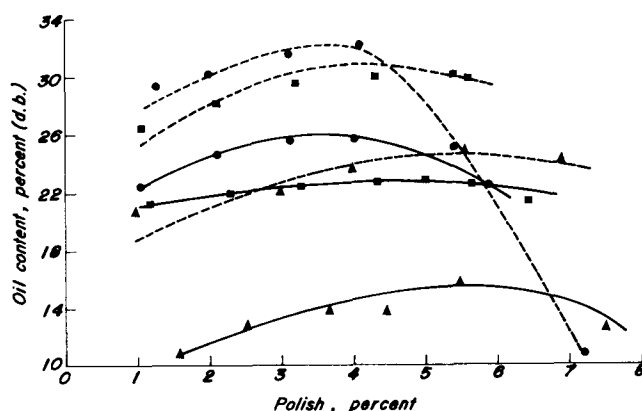


FIG. 1. Relationship between percentage polish and oil content of bran from different varieties of raw (—) and parboiled (---) rice. Varieties: IR-22 (●), Jaya (■), and Bala (▲); d.b. means dry basis.

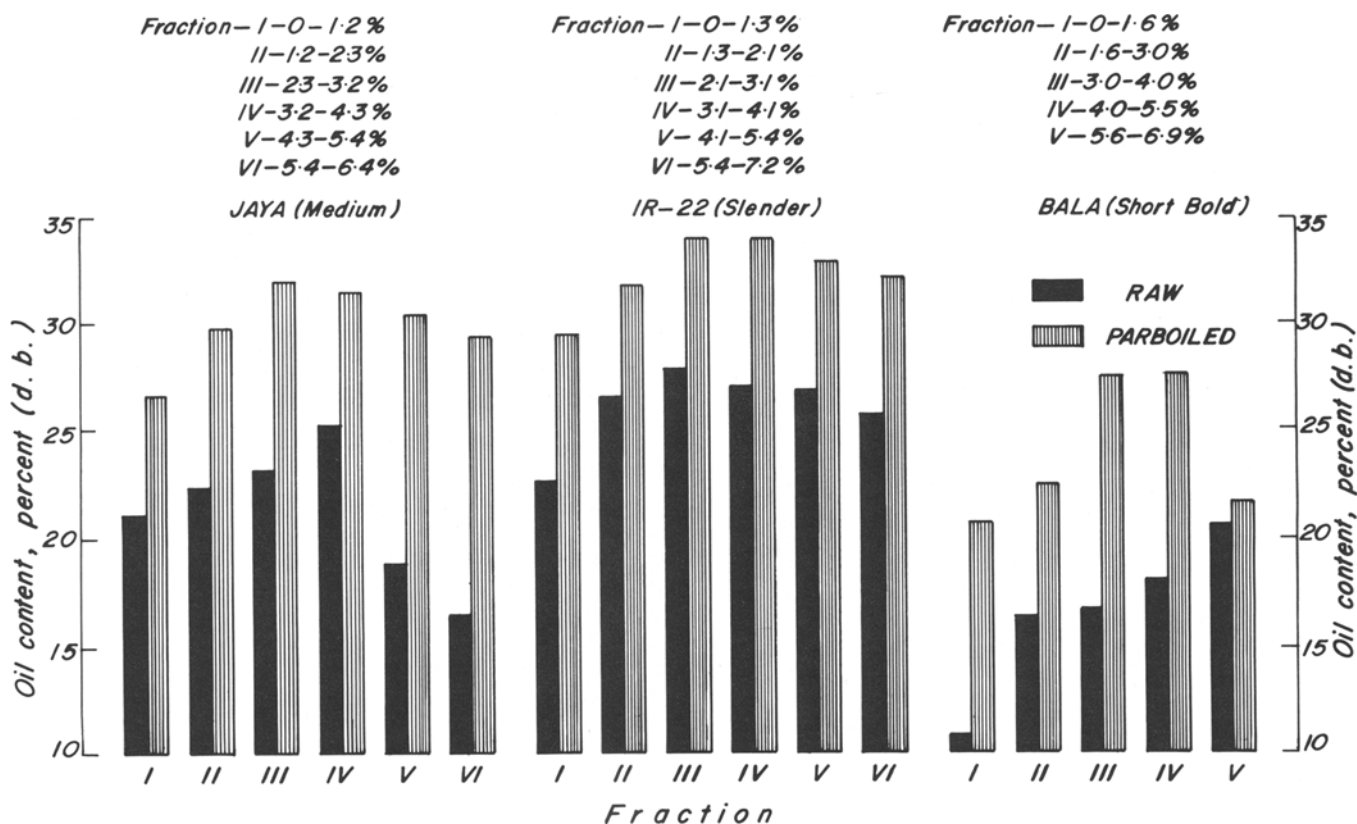


FIG. 2. Oil content in successive surface fractions from different varieties of raw and parboiled rice; d.b. means dry basis.

(about 10%). An important point to note from the figure is that the slender variety IR-22 showed a sharp drop from about 32 to 11% oil beyond 5% polish, suggesting a relatively higher concentration of oil bodies in the outermost bran layers in this variety. In the short grain variety Bala, on the other hand, parboiling increased the oil content in layers beyond 5.5% and up to 7.0% polish, whereas in the raw samples the oil content sharply declined beyond about 5.5% polish. In the medium variety Jaya, the changes were not very appreciable except that the values were higher for the parboiled samples compared to the raw ones. From the results it would appear that the parboiled IR-22 rice would need to be polished less than the other two varieties, especially the variety Bala.

Oil Content of Successively Removed Bran Layers from Kernel Surface

The results on the oil content of successive surface layers of bran are presented in Figure 2. The general trends or patterns of distribution of oil are more or less similar to those presented in Figure 1. IR-22 again was found to have the highest content of oil in each of the successive fractions compared to the other two varieties, Jaya and Bala. Oil content in IR-22 and Jaya increased up to Fraction III or IV and then decreased — a pattern reported earlier in other varieties by Raghavendra Rao et al. (3) and Barber (4). In the short grain Bala, the increase in oil content continued up to the last fraction removed (Fraction V) — indicating undermilling even at more than 6% polish. Moreover, in the slender IR-22, the fractions showing the highest and the lowest values of oil had a difference which was small (about 5%), whereas in the coarse varieties Jaya and Bala, it was much larger (about 8-10%). This indicates a considerable difference in the pattern of oil distribution in the bran layers of fine and coarse varieties, the former showing concentrated and a relatively more even distribution than the

latter.

Fractions from the parboiled samples yielded more oil than the corresponding raw fractions (Fig. 2). In IR-22, the increase was 5-7% in each different fraction. It was about 5-13% in Jaya and about 1-11% in Bala. Moreover, in Jaya the increase in parboiled over raw samples was small in Fractions I to IV and large in Fractions V and VI, while in Bala, the trend was opposite, that is, the increase was much larger in the first few fractions and became small in the last fraction (Fraction V). This again seems to indicate that distribution of the oil bodies may be restricted to the more superficial layers in IR-22 compared to Jaya and Bala. The possibility, however, of differential extractability of parboiled bran with solvent in the different varieties and also in the different fractions is not ruled out. As for the germ contributing to the oil, it is fully removed during milling of both raw and parboiled rice and gets mixed with bran, so that its contribution to the bran oil is about the same in raw as well as in parboiled rice bran.

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