

NOTE

Microstructure of the Seed Coat of Faba Bean (*Vicia faba* L.) Seeds of Different Cookability¹

M. M. YOUSSEF² and W. BUSHUK, Department of Plant Science, University of Manitoba, Winnipeg, Canada R3T 2N2

The phenomena that make legumes hard to cook are serious technological problems. Water absorption by the cotyledon appears to be the key property that affects cookability of legumes (Sefa-Dedeh et al 1979). It is not clear which morphological components of the seed are responsible for differences in water absorption among cultivars and seeds of the same cultivar. In this

research note, we present some new information on the microstructure of the seed coat of faba beans that might be related to differences in cookability.

TABLE I
Cookability Characteristics of Seed and Crude Protein Content of Seed Coat of Faba Bean Samples

Characteristic	Canadian		Egyptian	
	A (soft)	B (hard)	C (soft)	D (hard)
Cookability index ^a (mm)	8.58	5.07	8.20	4.32
Seed coat (%)	13.5	13.8	13.9	15.4
Hydration coefficient	273	273	284	250
Crude protein (%)	4.68	5.52	5.05	4.68

^a Average of 100 readings.

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²Present address: Department of Agricultural Industries, Faculty of Agriculture, University of Alexandria, Egypt.

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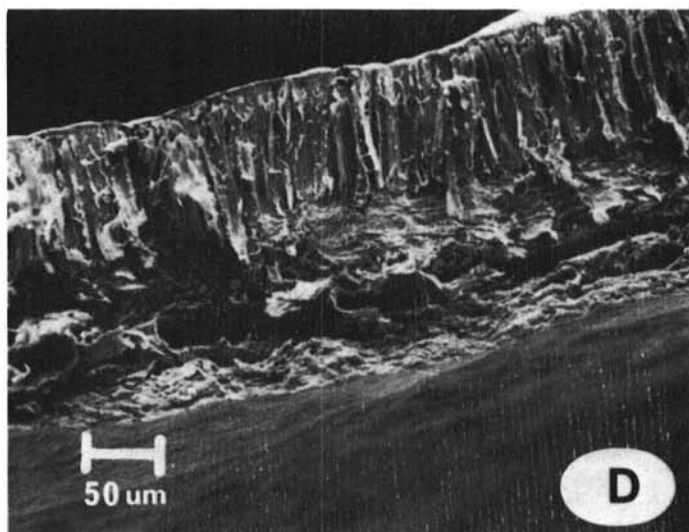
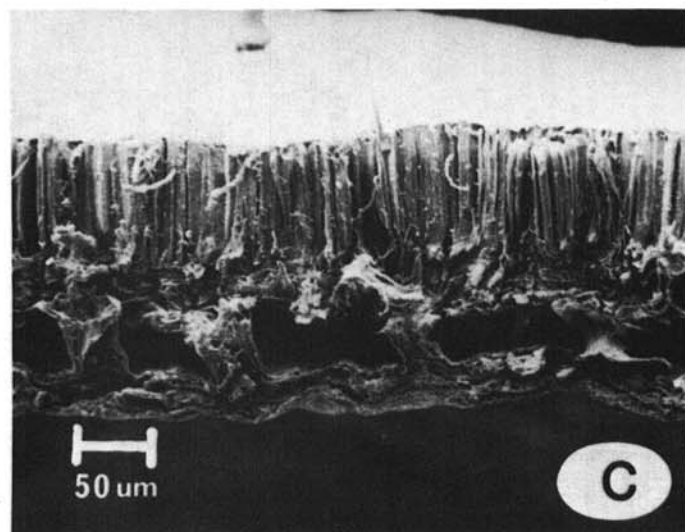
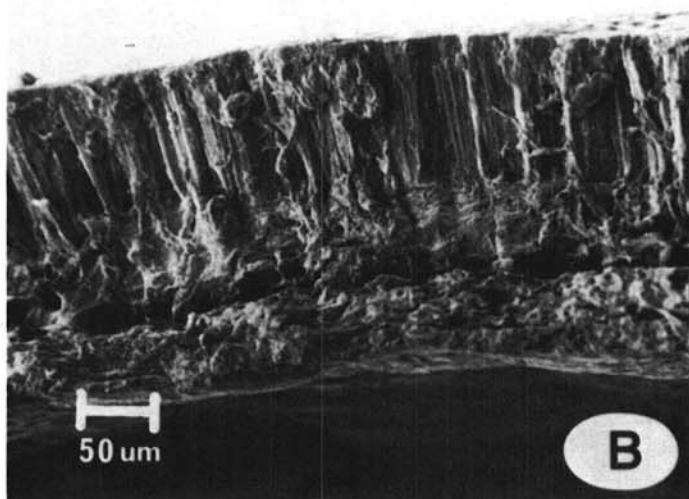
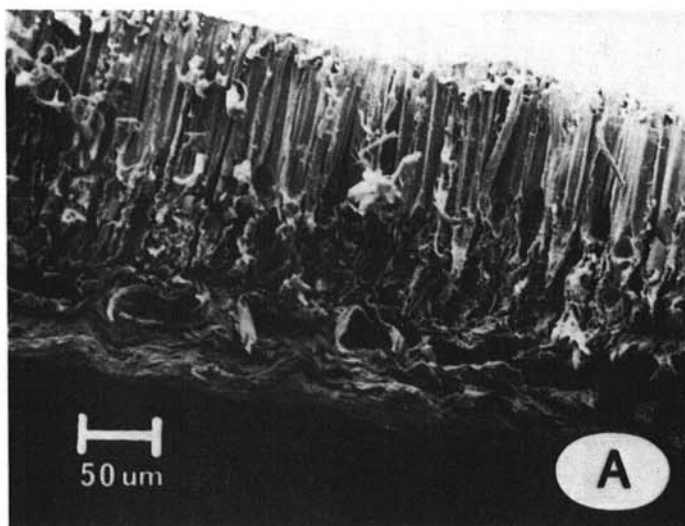


Fig. 1. Scanning electron micrographs of faba bean seed coats with different thicknesses. **A, B**, soft- and hard-cooking Canadian samples, respectively. **C, D**, soft- and hard-cooking Egyptian samples, respectively.

MATERIALS AND METHODS

Four samples of faba beans (A and B from Canada, and C and D from Egypt) were selected from the 20 samples used in a previous study (Youssef et al 1982). The samples of each pair represented extremes in cookability. Quick-cooking samples (A and C) are referred to as "soft" and slow-cooking samples (B and D) as "hard." The two samples from each pair were stored under the same conditions after harvest.

Characteristics used as indices of cookability were cookability index, hydration coefficient of stewed beans, and seed coat percentage (Youssef et al 1982). Crude protein ($N \times 5.85$) content was determined by AACC method 46-12 (AACC 1983).

Sections of the mature seed coat were separated from the cotyledon by hand with a sharp razor blade. Seed coat thickness, the micropyle, and hourglass cells were examined on a Cambridge Stereoscan MK 11A scanning electron microscope (SEM) as described by McEwen et al (1974).

RESULTS AND DISCUSSION

Seed coat percentage and hydration coefficients of stewed seeds were not significantly different for Canadian samples having different cookability (Table I). Accordingly, their different cookability cannot be explained on the basis of these two characteristics. The Egyptian samples differed in these two characteristics. The two Canadian samples differed in seed coat

protein content, which may have influenced the difference in cookability. Seed coat protein content was suggested (Snyder 1936) to affect the cookability of some commercial classes of dry edible beans (*Phaseolus vulgaris* L.).

The SEM micrographs (Fig. 1) show that the seed coat palisade cells varied in thickness and in length. The microstructural differences between the two Egyptian samples (C and D) were more evident than those between the two Canadian samples (A and B). The cells of the hard-to-cook Egyptian sample (D) were thicker and longer than those of the softer sample (C). Differences between the Canadian and Egyptian samples of approximately the same cookability were small but discernible. The cells of both Canadian samples were longer and less compact than those of the Egyptian samples.

The micropyle is situated just below the hilum in legume seeds. A distinct elliptical micropyle was visible in the SEM photomicrographs (Fig. 2). The samples of different cookability differed in thickness of the cell layer adjoining the micropyle and in width of the micropyle opening. In general, the hard-to-cook Egyptian samples, the cookability of which was strongly dependent on the seed coat, had smaller micropyle openings and thicker cell layers. These observations on the micropyle region are consistent with information published for other grain legumes. For example, Powrie et al (1960) showed that in dry field beans (*P. vulgaris*) of the navy commercial class, water enters the cotyledon unobstructed through the micropyle. Snyder (1936) showed that entry of water into Great Northern beans decreased from 52 to 3.8% over 24 hr of

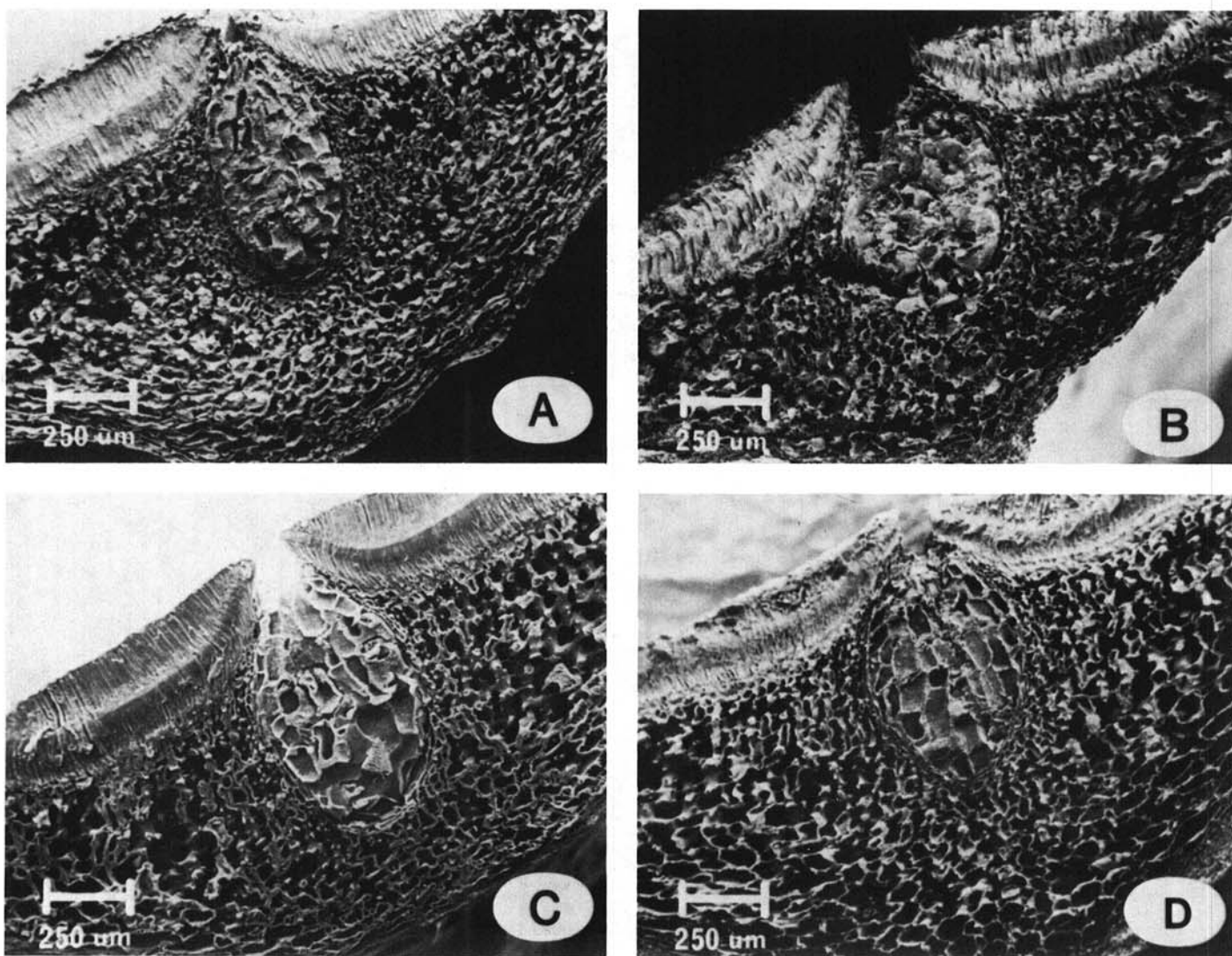


Fig. 2. Scanning electron micrographs of cross section of faba bean seed coats showing the hilum and micropyle. A, B, soft- and hard-cooking Canadian samples, respectively. C, D, soft- and hard-cooking Egyptian samples, respectively.

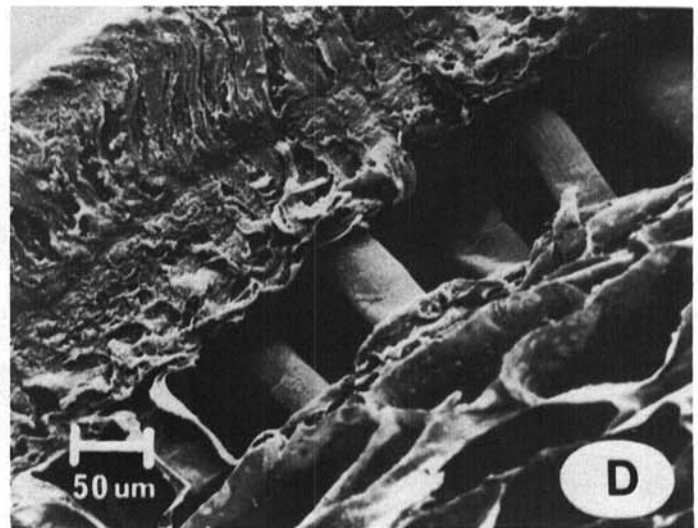
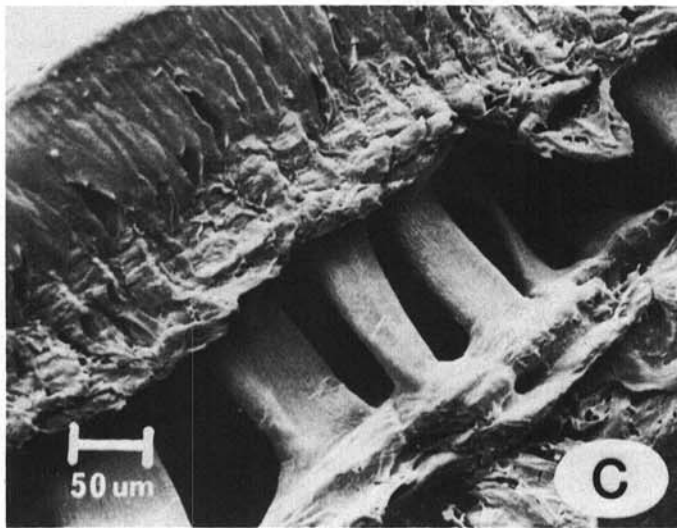
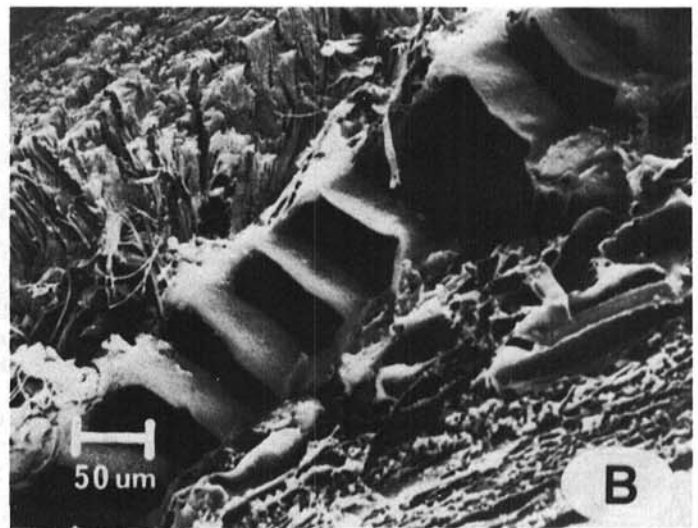
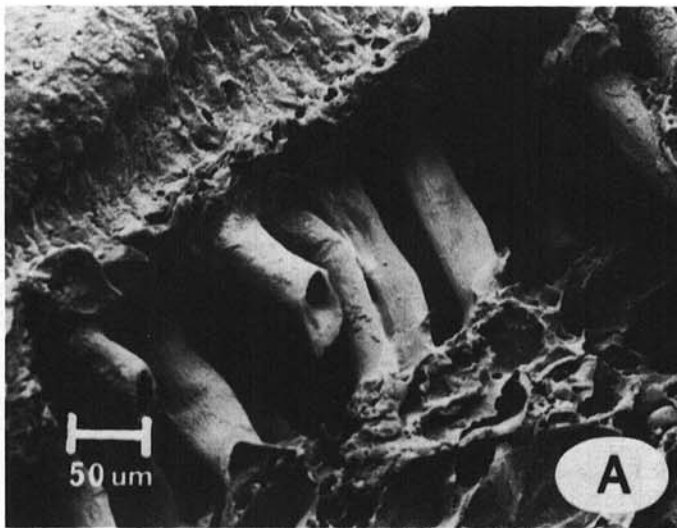


Fig. 3. Scanning electron micrographs of cross section of faba bean seed coat showing the hourglass cells. A, B, soft- and hard-cooking Canadian samples, respectively. C, D, soft- and hard-cooking Egyptian samples, respectively.

soaking when the micropyle was covered with water-resistant cement.

The hard-to-cook faba bean samples (Fig. 3B and D) had shorter hourglass cells than samples with better cookability (Fig. 3A and C). Since these cells are distinctly separate from the hilum, further investigation of the possible relationship between microstructure of hourglass cells and cookability of faba beans would be worthwhile.

Results of this study showed that faba beans with different degrees of cookability varied in seed coat microstructure. Some aspects of the microstructure control the rate of water penetration into the cotyledon during all stages of cooking. Those aspects could be related to cookability. Differences in cookability among varieties grown in the same or in diverse production areas may be caused by seed microstructure differences that regulate water penetration and movement within the seed.

On the other hand, cookability may also be controlled by intrinsic properties of the cotyledon components and the cotyledon structure (Youssef et al 1982).

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