NOTE

Folate Content of Bran from Different Wheat Classes

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Whole grain cereal foods are acknowledged as a good source of folate, a vitamin that is essential for general good health, particularly in the prevention of megaloblastic anemia (Perloff and Butrum 1977). Other major sources of folate include green vegetables and liver, but in many cultures breads and other cereal products are a prime source (Dutta et al 1980, Hoppner and Lampi 1982). Few references to the folate content of bran are found in the literature (Lillie and Briggs 1947, Calhoun et al 1960, Butterfield and Calloway 1972). Recently, bran and bran products have become more popular, as breakfast cereals and bakery items, as a result of the trend to introduce more fiber into the diet. This paper reports the folate content of bran from several common varieties and classes of Canadian wheat together with commercial and check samples.

MATERIALS AND METHODS

Samples of amber durum (AD), hard red spring (HRS), and soft white spring (SWS) wheat brans were obtained from the Canadian Grain Commission, Grain Research Laboratory, Winnipeg, Manitoba. AD varieties were milled according to the scheme described by Matsuo and Dexter (1980); the brans were separated after the third break passage and not passed through the bran finisher. These samples, grown in 1982, were composites from stations in Manitoba, Saskatchewan, and Alberta. HRS varieties were milled by the Allis-Chalmers laboratory mill described by Black et al (1980); this involves three break passages followed by two passes through the bran finisher. The central Canadian HRS (Table I) samples were composites from Manitoba and eastern Saskatchewan, the other set, western Canadian (Table I), were from Alberta and western Saskatchewan. Both samples of SWS varieties were grown in southern Alberta; these wheats were milled according to Black et al (1980), given four break passages and two passes through the bran finisher. The soft white winter (SWW) wheats were grown in Ontario and milled at the Plant Research Centre, Agriculture Canada, in a Buhler laboratory mill MLU-202. Bran was separated after three break passages and not passed through a bran finisher. The milling process for the commercial bran and AACC standard reference brans (Table I) was not known. Moisture determinations were carried out on a 2-g sample by drying in a lab drying oven at 115°C for 18 hr to constant weight.

Free and total folate were determined according to the method of Hoppner et al (1972) using *L. casei* ATCC 7469. Chicken pancreas conjugase enzyme (Difco Laboratories, Detroit, MI) was used in the total folate assay. The sodium phosphate buffer, pH 8.0, contained 2 mg/ml ascorbic acid. Samples were incubated for 18 hr at 37°C.

A standard calibration was conducted using pteroglutamic acid with each assay; the folacin content of Bacto-Liver (Difco Laboratories, Detroit, MI) was also determined to monitor any contamination in the microbiological procedure. Approximately 2 g of each bran was ground for 30 sec in a small coffee mill (Braun AG model KSM 1) immediately before analysis so that a uniform sample could be taken. Folate was extracted from the bran by placing the tubes containing the sample and buffer into a boiling water bath for 10 min. After preliminary determination of folate in each bran cultivar, the initial sample weights and dilutions were adjusted to give concentrations within the range of the standard curve. The corresponding concentration was determined from the curve and the average reading was used for statistical analysis. Because the data were highly unbalanced, the generalized linear model procedure (SAS Institute 1985) was used to analyze the appropriate subset of data.

RESULTS AND DISCUSSION

The bran samples of this study were obtained from milling trials in a single year. This limits the scope of the survey to the most common varieties in each wheat class and the statistical treatment of the folate data. It should also be noted that three slightly different milling procedures were used. Ideally only one procedure should be used to eliminate milling effects; however, the data presented are not available elsewhere and are useful in determining the nutritional value of bran and in choosing brans for better folate content. In preliminary work it was found that ground samples were easier to handle than milled bran, particularly in the extraction step where wetting with buffer is difficult. No variation in free or total folate content was observed in a series of samples from a single bran source, ground to <0.1 mm, <120 mesh, and <200 mesh.

In Table I the free and total folate content of the four wheat types are shown. There is a significant difference ($P < 0.05$) in total folate content between the soft wheats (SWW and SWS) and the hard wheats (HRS and AD). The free folate does not show the same pattern, the HRS being higher than any of the other three wheat classes. The accuracy of the measurement of free folate is

TABLE I
Folate Content of Wheat Bran From Different Wheat Classes and Sources

Wheat Type or Sources	Number of Varieties	Mean Folate (μg/g of bran dry wt)[a] Free	Total
Test samples			
Hard red spring	7	0.76 (21) a	2.24 (38) c
Durum	6	0.56 (19) b	2.42 (25) c
Soft white winter	7	0.33 (35) c	3.60 (56) a
Soft white spring	2	0.54 (6) b	3.39 (10) b
EMS[b]		0.0034	0.0919
Commercial and Reference Samples			
Quaker natural[c]		0.37 (6) a	1.84 (5) a
Health food store bulk[c]		0.36 (5) a	1.40 (4) b
AACC soft white[d]		0.24 (6) c	2.10 (3) a
AACC hard red		0.30 (3) b	1.45 (4) b
EMS[b]		0.0007	0.0452

[a](N) indicates number of samples from all locations. Means with same letter are not significantly different at $P < 0.05$.
[b]Error mean square.
[c]Purchased at local stores.
[d]American Association of Cereal Chemists reference samples.

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TABLE II
Mean Total Folate (μg/g bran dry wt) of Wheat Brans According to Class and Growing Location

Class/Variety	Growing Location[a] A		B	
	Woodstock (Ontario)		Ottawa (Ontario)	
Soft white winter				
Augusta	4.23	(3)	4.06	(4)
Frederick	4.06	(3)	3.70	(4)
Frankenmuth	3.75	(4)	3.58	(4)
Houser	3.72	(4)	3.53	(6)
Yorkstar	3.48	(5)	3.32	(4)
Favor	3.28	(4)	3.34	(4)
Gorden	3.16	(3)	3.47	(4)
EMS[b]	0.1351		0.0011	
	Lethbridge (Alberta)			
Soft white spring				
Dirkwin	3.28	(3)		
Fielder	3.50	(3)		
EMS	0.080			
	Western[c]		Central[d]	
Hard red spring				
Columbus	2.00	(4)	2.75	(3)
Neepawa	2.24	(2)	2.51	(4)
Marquis	2.14	(3)	2.16	(4)
Leader	1.82	(4)		
Canuck	2.25	(6)		
Benito			2.78	(3)
Sinto			2.02	(5)
EMS	0.0811		0.0467	
Amber durum				
Wascana			2.81	(3)
Wakooma			2.57	(5)
Coulter			2.47	(5)
Medora			2.28	(4)
Hercules			2.21	(4)
DT 371			2.21	(4)
EMS	0.0449			

[a](N) indicates number of samples.
[b]Error mean square.
[c]Western = Alberta and Saskatchewan.
[d]Central = Manitoba and eastern Saskatchewan.

sometimes questioned because the inherent conjugase may affect the results. Whether the high free folacin in HRS was naturally occurring or resulted from an active innate conjugase was not established in this study; therefore, further statistical analysis on "free" folate was not pursued.

The milling procedures for HRS and SWW were similar as were the procedures for SWS and AD. Based on the present data there was no evidence of any relationship between the milling procedure and the free or total folate, except for the minor dilution effect of residual endosperm in brans not passed through a finisher. The milling procedure was not included as a factor in the statistical analysis.

In Table II the mean total folate of the varieties in each wheat class, according to location, is shown. In the SWS brans only two varieties were involved, both from western Canada, they were not significantly different from each other ($P > 0.08$). The AD brans were all composites from one source; significant intervarietal differences were evident ($P < 0.01$). HRS brans were obtained from two locations with three varieties common to both. The location effect was tested with varieties grown in both locations where a slight difference ($P < 0.05$) was found.

All the SWW varieties in this study were grown in two different locations. The four varieties with the most total folate occurred in the same order in both locations; significant differences between varieties were evident. The variety-by-location interactions were tested, but there was no evidence ($P > 0.65$) for this interaction in the SWW brans, and for HRS it was not statistically significant ($P > 0.05$).

TABLE III
Ranked Mean Total Folacin Content of All Wheat Brans

Wheat Class[a]	Variety	Mean, Total Folacin (μg/g bran dry wt)[b]
SWW	Augusta	4.14 (7) A
SWW	Frederick	3.85 (7) AB
SWW	Frankenmuth	3.67 (8) BC
SWW	Houser	3.60 (10) BC
SWS	Fielder	3.50 (5) BC
SWW	Yorkstar	3.41 (9) C
SWW	Gorden	3.34 (7) C
SWW	Favor	3.31 (8) C
SWS	Dirkwin	3.28 (5) C
AD	Wascana	2.81 (3) D
HRS	Benito	2.78 (3) D
AD	Wakooma	2.57 (5) DE
AD	Coulter	2.47 (5) DE
HRS	Neepawa	2.42 (6) DEE
HRS	Columbus	2.32 (7) EF
AD	Medora	2.28 (4) EF
HRS	Canuck	2.25 (6) EF
AD	Hercules	2.21 (4) EFG
AD	DT 371	2.20 (4) EFG
HRS	Marquis	2.15 (7) EFG
HRS	Sinto	2.02 (5) FG
HRS	Leader	1.82 (4) G
EMS[c]		0.0921

[a]SWW = Soft white winter; SWS = soft white spring; AD = amber durum; HRS = hard red spring.
[b](N) indicates number of samples. Means with same letter are not significantly different at $P > 0.05$.
[c]Error mean square.

In order to provide a general view of the total folate content for all varieties and classes, the data for total folate were pooled for analysis, and the results are shown in Table III. The most striking feature is the marked difference between the soft and hard wheats—they fall into distinct categories without any overlapping. This contrasts directly with what has been found in flours (Keagy et al 1980), where those derived from hard wheats contain more folate than from soft wheats. The explanation may be that more of the aleurone layer of hard wheat is transferred to the flour during the milling process.

Results for commercial and AACC reference samples are summarized in Table I. The AACC samples are of particular interest, because the hard wheat bran is significantly lower in total folate than the soft wheat bran, but both are significantly lower than their counterparts in the main survey. According to a technical data sheet supplied by AACC, the certified wheat bran had been processed in an enzyme deactivation steamer before storage. This process could have significantly reduced heat-labile folate.

In summary, the results of this one-year study showed that wheat brans are a good source of folate and that there is a demonstrable difference in the folate content of brans from soft and hard wheats. With the increased use of bran in food formulations, dietitians should at least be aware of this fact, particularly when designing high-fiber diets.

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