Cooperative Extension Research Report

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Nutrition of Local Flour

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INTRODUCTION

Small-scale milling has seen a resurgence over the last two decades in the United States as consumer interest in local foods extended to grains, flours, and bread. According to small-scale millers in the Northeast and Midwest, nutrition is one of the key marketing points that resonates with their customers. However, due to the cost of full nutritional analysis, many small-scale millers do not analyze their products. Instead, they use fee-based nutritional label services, such as ReciPal (www.recipal.com), that access the USDA FoodData Central (FDC) database of nutrition analyses for ingredients and products. The closest comparable products currently available in that database are produced by commodity-scale mills and may not be representative of the products produced by small-scale mills. For instance, some of the small-scale millers who participated in this project use nutrition information for all-purpose white flour in their labels of their sifted flours for lack of a more representative product in the database.

Research Questions:

- Do the flours produced by local small-scale mills differ nutritionally from those produced by commodity-scale mills?
- Do the nutritional labels used by local small-scale mills accurately reflect their products?

This project was part of the “Value-Added Grains for Local and Regional Food Systems” project led by Cornell University and funded by USDA-NIFA.

RESEARCH METHODS

Twenty-eight flour samples from eight small-scale flour mills in the Northeast and Midwest United States (Table 1) were submitted to Great Plains Analytical Laboratory (Kansas City, Missouri) in February 2024 for standard nutritional analysis (calories, total fat, saturated fat, trans fat, cholesterol, sodium, carbohydrate, total dietary fiber, total sugar, protein, vitamin D, calcium, iron, and potassium) and moisture.

Nutritional label from flour produced by a small-scale mill in the Northeast. Photo courtesy of Ground Up, Hadley, MA.

Are you required to put a nutrition label on your product?

Section 403(q) of the Federal Food, Drug, and Cosmetic Act requires that packaged food carry a nutrition label unless the business selling the product qualifies for a Small Business Exemption. A business can qualify if: 1. their annual gross sales are less than $500,000 or their annual gross sales of food products to consumers are less than $500,000, OR 2. they employ less than 100 people and sell less than 100 units annually in the US. Some small-scale mills choose to include a nutrition label on their product even though they qualify for these exemptions. For more information, see the USDA's Labeling and Nutrition Guidance Documents and Regulatory Information.

Sample metadata was collected from the millers and included wheat type (hard red, winter or spring), variety, farm that provided the wheat grain and their location, whether the wheat was certified organic, growing year, mill type, and extraction rate.

All flour samples were milled from hard red wheat. There were four varieties of spring types and four varieties of winter types, with one variety, Red Fife, which is a facultative spring wheat, being grown as both. For all samples, wheat grain was sourced from within the region where the mill is located, and for most samples, the wheat was grown in the same state as the mill. All flour samples were produced using a stone burr mill. Five of the millers used New American mills and the other three used an Osttiroler, a Meadows, and an Engsko stone mill. Millers submitted either whole ground flour, sifted flour, or both, and most submitted more than one variety. Extraction rates for the sifted flour samples ranged from 75 to 92% and averaged 84%. The three mills who, at the time, included nutritional labels on their products submitted those labels. The labels were generated from a nutritional label service for two mills and from product testing for the other.

Table 1. Characteristics of the 28 flour samples collected from small-scale mills in the Midwest and Northeast and analyzed for nutritional content. Each mill submitted two to four samples.

				Flour samples submitted and their extraction rates	
				Whole non-sifted	
Mill	**State**	**Variety**	**Wheat type**		**Sifted**
				---------- % ----------	
Bakers Field Flour & Bread	MN	Bolles	Hard Red Spring	.	80
Bakers Field Flour & Bread	MN	Forefront	Hard Red Spring	.	85
Bakers Field Flour & Bread	MN	Redeemer	Hard Red Winter	100	80
Brooklyn Granary & Mill	NY	Bolles	Hard Red Spring	100	92
Brooklyn Granary & Mill	NY	Red Fife	Hard Red Winter	.	92
Brooklyn Granary & Mill	NY	Redeemer	Hard Red Winter	.	92
Janie's Mill	IL	Glenn	Hard Red Spring	100	80
Janie's Mill	IL	Warthog	Hard Red Winter	100	80
King Arthur	VT	Bolles	Hard Red Spring	100	88
Maine Grains	ME	Glenn	Hard Red Spring	100	75
Maine Grains	ME	Glenn	Hard Red Spring	.	86
Maine Grains	ME	Red Fife	Hard Red Spring	100	.
Meadowlark	WI	Champlain	Hard Red Winter	100	83
Meadowlark	WI	Red Fife	Hard Red Winter	100	83
NEK Grains	VT	Warthog	Hard Red Winter	100	83
Valley Malt/Ground Up	MA	Glenn	Hard Red Spring	100	83

Valley Malt/Ground Up	MA	Warthog	Hard Red Winter	100	83

How closely does your product need to match its label?

According to the FDA Nutrition Labeling Manual: A Guide for Developing and Using Databases, class II nutrients (vitamins, minerals, protein, total carbohydrate, dietary fiber, other carbohydrate, polyunsaturated and monounsaturated fat, and potassium that occur naturally in a food product) "must be present at 80% or more of the value declared on the label".

The FDC database was accessed on February 9, 2025 to identify entries that were most comparable to the small-scale mill samples. A search of the database was conducted by selecting the "Flours & Corn Meal" category and using the keywords "stone-ground" or "whole wheat" for whole ground wheat flour and the keywords "stone-ground" or "all purpose" for sifted wheat flour. The resulting entries were then evaluated for best fit, with those deemed incompatible discarded. Eight whole ground flours and six sifted flours were identified to compare with the small-scale mill samples (Table 2).

Table 2. Flour products from the FoodData Central database identified as most comparable to the small-scale flour samples.

Flour type	Brand	Product description	Global Trade Item Number
Whole ground	Bob's Red Mill	Stone ground organic whole wheat flour	39978029874
Whole ground	Bob's Red Mill	Organic whole wheat flour	39978019875
Whole ground	Hodgson Mill	Whole wheat flour	71518050054
Whole ground	Idaho Grain	Whole wheat flour	700112557699
Whole ground	King Arthur Flour	100% organic bread flour	71012081035
Whole ground	King Arthur Flour	100% organic whole wheat flour	71012081004
Whole ground	King Arthur Flour	100% organic whole wheat flour	71012081011
Whole ground	King Arthur Flour	100% organic whole grain whole wheat flour	71012050505
Sifted	Great River	100% organic all purpose whole wheat flour	684765140050
Sifted	King Arthur Flour	100% Organic all-purpose flour	71012080069
Sifted	King Arthur Flour	100% organic bread flour	71012081035
Sifted	King Arthur Flour	100% organic unbleached bread flour	71012081042
Sifted	Hodgson Mill	50/ 50 whole wheat & white flour	71518050153
Sifted	North Country Farms	Unbleached white all purpose flour	899386002100

Nutrient analysis results for the small-scale mill samples were corrected to a standard 12.4% moisture to facilitate comparisons among mills. The FDC database does not include moisture for the flour entries. It was assumed that those data are reported on an "as-is" moisture basis and are included here as such. All values are reported as amount per 100g unless otherwise noted.

A series of two-sample comparisons were made using Welch's t-test when data were normally distributed and the non-parametric Kruksal Wallis test when data were not normally distributed. The FDC database entries were first compared with the mill labels, to determine if the entries selected were representative of the information currently used on the mill's labels, and then compared with the mill samples, to determine if the entries were representative of the actual products. Finally, Northeast and Midwest mill samples were compared to evaluate the possibility of a region effect on flour nutrition. Other potential effects, such as variety or mill type, were not conducted due to the limited dataset.

RESULTS

No statistically significant differences were observed for any of the nutrients analyzed between the FDC database entries and the two mill labels generated by label services (data not shown), confirming that the entries selected from the database are representative of those used by nutrition label services to generate labels for these small-scale mills.

However, there were substantial differences between the FDC database entries and the small-scale mill samples (Table 3). Most notably, total fiber was 39% and 86% higher, calcium was 196% and 520% higher, and iron was 34% and 102% higher, for whole non-sifted and sifted flour, respectively, than for their comparative FDC database entries. Total sugar was also substantially higher but many of the FDC entries had sugar levels as zero, which is likely a simplification. Saturated fat was higher, but only for whole non-sifted flour. Calories were 9% lower for the flour samples than for the FDC entries for both types of flours. Protein was also lower, but only for sifted flour.

It is unclear why the nutritional composition of whole non-sifted flour differs between small-scale mill samples and the FDC database entries. However, for sifted flour, small-scale mill products likely have more bran and germ than the all-purpose flours they were compared with from the FDC database, and these grain components contain more fiber, calcium and iron than the endosperm (Fardet 2010, Moore et al. 2012).

Using "as-is" results instead of moisture-corrected results for the mill samples did not change the results from those in Table 3. "As-is" results differed from moisture-corrected values by only 0.07% for whole non-sifted flour and 2.0% for sifted flour.

Table 3. Average nutrient concentration of flour from small-scale mills (reported at 12.4% moisture) and of similar products in the FoodData Central database (reported on an "as-is" moisture basis).

Nutrient	Whole non-sifted flour			Sifted flour		
	Small-scale mills (n=12)	FDC database (n=8)†	p	Small-scale mills (n=16)	FDC database (n=6)†	p
	---------- per 100g ----------			---------- per 100g ----------		
Calories	309.4 ± 2.5	341.3 ± 17.1	**	327.1 ± 5.3	360.2 ± 14.3	***
Total fat, g	2.4 ± 0.1	2.0 ± 0.5	NS	2.1 ± 0.1	1.4 ± 1.7	NS
Saturated fat, g	0.53 ± 0.03	0.13 ± 0.2	**	0.48 ± 0.03	0.0 ± 0.0	-
Trans fat, g	non-detect	0.0 ± 0.0	-	non-detect	0.0 ± 0.0	-
Cholesterol, mg	non-detect	0.0 ± 0.0	-	non-detect	0.0 ± 0.0	-
Sodium, mg	1.4 ± 0.4	0.5 ± 0.8	NS	1.2 ± 0.4	0.5 ± 1.3	NS
Total carbohydrate, g	71.4 ± 1.5	69.9 ± 2.0	NS	72.5 ± 1.3	73.3 ± 2.2	NS
Total fiber g	15.8 ± 0.6	11.4 ± 1.2	***	11.3 ± 1.5	6.1 ± 4.1	*
Total sugar, g	2.2 ± 0.4	0.8 ± 1.0†	*	2.1 ± 0.2	0.6 ± 1.4	*
Protein, g	12.1 ± 1.4	13.2 ± 2.0	NS	11.9 ± 1.1	13.3 ± 0.02	**
Vitamin D, µg	0.0 ± 0.0	0.0 ± 0.0†	-	0.0 ± 0.0	0.0†	-
Calcium, mg	36.3 ± 2.7	12.3 ± 16.2	**	27.9 ± 2.2	4.5 ± 11.6	**
Iron, mg	4.7 ± 0.4	3.5 ± 0.6	**	4.0 ± 1.1	2.0 ± 0.9	**
Potassium, mg	381.7 ± 99.6	356.3 ± 34.8†	NS	246.6 ± 40.5	383.0†	-

† For whole non-sifted flour, total sugar n=7, vitamin D n=2, and potassium n=3. For sifted flour, vitamin D n=1 and potassium n=1.

*, **, *** significant at the 0.05, 0.01, and .001 probability level, respectively. NS, nonsignificant.

A direct comparison of small-scale mill samples with their corresponding product labels showed that the small-scale millers may be underrepresenting the nutritional value of their products in some cases and over-representing in others (Tables 4 and 5). In 10 of 12 cases, the small-scale mill samples were higher than the label values for total fiber, calcium, and iron, echoing the results from the comparison with the FDC entries. When higher, fiber levels were 138-276% of their label value. This difference represents a substantial increase in the percentage of the recommended daily value for fiber (28g, FDA, citation) that a 30g serving would provide, from 7-11% of the RDV for the label value to 15-17% of the RDV for the flour sample for whole non-sifted flour, and from 4-11% of RDV to 9-13% of RDV for sifted flour. For iron, the difference between the samples and their labels was more moderate (110-167% of the label value), as was the increase in the percent of the 18 mg RDV provided by a 30g serving, from 5.6-6.1% to 6.7-9.3% of RDV for whole non-sifted flour and from 0-6% to 5-18% of RDV for sifted flour. The difference for calcium between sample and labels was similar to that for iron (85-171% of the label value) but because flour is not a significant source of calcium, the increase in the percentage of the 1,300 mg RDV for calcium was negligible, from 0.4-0.8% to 0.5-1.0% over both flour types. Using mill sample results at "as-is" moisture levels altered the percent of label value only slightly (0-2% points) and did not affect the overall pattern of the results.

In most cases where small-scale mill sample values were lower than the label value, the nutrient levels for small-scale mill samples met FDA requirements to be at least 80% of value on the label. Exceptions were total fat (6 cases), potassium (5 cases), protein (3 cases), and iron (1 case although it was 79%). Results for total fat and potassium were notably variable, with sample values ranging from 56% to 156% of label values for total fat and from 72% lower to 237% of label values for potassium.

Table 4. Discrepancies in nutrient concentrations between small-scale mill samples and each mill's product label for whole, non-sifted flour. Differences are expressed as the percent difference between sample and label values, or as the sample value when the label value was zero.

	Mill A†			Mill B			Mill C		
	Label	% of label value		Label	% of label value		Label	% of label value	
Nutrient	value	Smpl. 1	Smpl. 2	value	Smpl. 1	Smpl. 2	value	Smpl. 1	Smpl. 2
	/100g	-- % or /100g --		/100g	-- % or /100g --		/100g	-- % or /100g --	
Calories	333	93%	94%	367	86%	86%	333	94%	93%
Total fat, g	1.7	134%	156%	0	(2.2g)	(2.9g)	3.3	71%	74%
Saturated fat, g	0	(0.5g)	(0.6g)	0	(0.5g)	(0.6g)	0	(0.5g)	(0.5g)
Trans fat, g	0	ND	ND	0	ND	ND	0	ND	ND
Cholesterol, mg	0	ND	ND	0	ND	ND	0	ND	ND
Total carb., g	70	103%	103%	67	106%	110%	73	95%	102%
Total fiber, g	10	144%	139%	7	221%	236%	10	161%	159%
Total sugar, g	0	(2.4g)	(1.7g)	7	29%	26%	0	(3.8g)	(2.7g)
Protein, g	13.3	84%	83%	16.7	78%	61%	13.3	106%	70%
Calcium, mg	33	114%	130%	20	171%	149%	33	110%	113%
Iron, mg	3.7	110%	113%	3.3	167%	161%	3.7	147%	119%
Potassium, mg	367	237%	92%	193	163%	159%	367	72%	86%

† Labels for Mills A and B were generated by a labeling service. Mill C's label was based on product testing.

Table 5. Discrepancies in nutrient concentrations between small-scale mill samples and each mill's product label for sifted flour. Differences are expressed as the percent difference between sample and label values, or as the sample value when the label value was zero.

Nutrient	Mill A†			Mill B			Mill C		
	Label value	% of label value		Label value	% of label value		Label value	% of label value	
		Smpl. 1	Smpl. 2		Smpl. 1	Smpl. 2		Smpl. 1	Smpl. 2
	/100g	-- % or /100g --		/100g	-- % or /100g --		/100g	-- % or /100g --	
Calories	333	99%	99%	367	92%	92%	333	98%	101%
Total fat, g	3.3	56%	73%	0	(1.8g)	(1.9g)	3.3	63%	65%
Saturated fat, g	0	(0.5g)	(0.6g)	0	(0.5g)	(0.4g)	0	(0.5g)	(0.5g)
Trans fat, g	0	ND	ND	0	ND	ND	0	ND	ND
Cholesterol, mg	0	ND	ND	0	ND	ND	0	ND	ND
Total carb., g	73	100%	99%	77	95%	98%	73	96%	103%
Total fiber, g	10	91%	91%	3	250%	276%	7	188%	138%
Total sugar, g	0	(1.8g)	(2.1g)	0	(2.0g)	(2.0g)	0	(2.7g)	(2.1g)
Protein, g	13.3	84%	85%	10.0	124%	99%	13.3	105%	66%
Calcium, mg	33.3	88%	85%	17.0	139%	126%	30.0	116%	93%
Iron, mg	3.7	79%	92%	0.0	(4.9g)	(2.8g)	2.3	470%	129%
Potassium, mg	367	63%	56%	107	167%	173%	267	71%	40%

† Labels for Mills A and B were generated by a labeling service. Mill C's label was based on product testing.

CONCLUSIONS

- Flour products produced from small-scale mills were distinct from the most comparable and currently available entries in the FDC database for fiber, sugar, calcium, and iron for both whole non-sifted and sifted flour, and for protein for sifted flour.
- By relying on the FDC database for nutritional information, small-scale mills may underrepresent the nutritional value of their products related to fiber, calcium, and iron and overrepresent, in some cases, for fat, protein, and potassium.
- The results highlight the need to make data from small-scale mills available in the FDC database.

REFERENCES

Fardet A. New hypotheses for the health-protective mechanisms of whole-grain cereals: what is beyond fibre? Nutrition Research Reviews. 2010;23(1):65-134. doi:10.1017/S0954422410000041

Food and Drug Administration (FDA). How to Understand and Use the Nutrition Facts Label. Retrieved April 13, 2025 from https://www.fda.gov/food/nutrition-facts-label/how-understand-and-use-nutrition-facts-label.

Food and Drug Administration (FDA). 1998. Guide for developing and using data bases for nutrition labeling. (content current as of 9/20/2018) FDA Guidance Documents. Retrieved April 14, 2025 from https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-guide-developing-and-using-data-bases-nutrition-labeling#manufacture.

Moore, K.L., F.-J. Zhao, C.S. Critsch, P. Tosi, M.J. Hawkesford, S.P. McGrath, P.R. Shewry, C.R.M. Grovenor. 2012. Localisation of iron in wheat grain using high resolution secondary ion mass spectrometry. Journal of Cereal Science. 55(2):183-187. doi.org/10.1016/j.jcs.2011.11.005.

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