

Nutrient Composition of Retail Samples of Sorghum, Millet and Whole Wheat Flour

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ABSTRACT

More than 2 million people in the United States have celiac disease, or about 1 in 133 individuals. People who have this disease cannot tolerate gluten, a protein in wheat, rye, and barley. The only treatment for celiac disease is a gluten-free diet. Nutrient profiles were lacking in the USDA National Nutrient Database for Standard Reference (SR) for sorghum and millet flour, both of which can be used in gluten-free diets. Three different brands of each type of flour were purchased from retail suppliers. Whole wheat flour samples were also obtained to update the existing nutrient profile. Samples were prepared at the Food Analysis Laboratory Control Center at Virginia Polytechnic Institute and State University and shipped by overnight delivery to analytical laboratories with appropriate analytical quality control and reference materials. These laboratories had previously been qualified to perform analyses of nutrients through the National Food and Nutrient Analysis Program. Samples were analyzed for proximate components, vitamins, minerals, and fatty acids. Whole wheat flour is highest in protein content at 13.2 % versus 10.8 % for millet, and 7.7 % for sorghum flour. Millet is the highest in total fat content at 4.9 % versus sorghum at 3.5 % and wheat at 2.5 %. Wheat flour is significantly higher (P <0.05) in calcium, iron, phosphorus, potassium, copper, and manganese compared to sorghum flour and significantly higher (P <0.01) in phosphorus, potassium, and manganese compared to millet flour. For health professionals who advise clients on food choices as well as for people who are trying to follow a gluten-free diet, having data for millet and sorghum flours in the SR provides an easily accessible and reliable source of nutrient information (www.ars.usda.gov/nutrientdata).

INTRODUCTION

Sorghum and millet are not frequently consumed in the U.S. but are alternative grains that are used in cooking by people who have celiac disease and cannot tolerate gluten, a protein in wheat, rye, and barley (Fasano et al., 2003). Samples of sorghum and millet flour were analyzed to provide nutrient data. Data for these flours will be included in the next release of the USDA National Nutrient Database for Standard Reference (SR) (USDA, 2009). Samples of whole wheat flour were also analyzed with the intent of updating the profile for that item in SR.

METHODS AND MATERIALS

Sampling Plan: Three brands of sorghum and millet flour were purchased from organic and health food stores in Blacksburg, VA and from the Internet. Three national brands of whole wheat flour were purchased from retail stores.

Sample Preparation: Samples were prepared for analysis according to standard protocols by a central processing facility at Virginia Polytechnic Institute and State University. Composites samples were shipped to the analytical laboratories along with quality control (QC) materials including standard reference materials and matrix specific QC materials developed in-house.

Sample Analysis: Laboratories used AOAC or other published methods to analyze proximate components, vitamins, minerals, and fatty acids. The commercial and university laboratories had been prequalified to analyze specific nutrients. When results for the QC materials were outside of accepted limits, samples were reanalyzed.

RESULTS AND DISCUSSION

One brand of each of the sampled millet and sorghum flours was identified on the label as "whole grain" and when contacted the other manufacturers stated that their products are whole grain. All three brands of wheat flour sampled claim whole grain on the label.

Proximates (See Figure 1)

- Carbohydrate: Sorghum has the highest carbohydrate level (77.22%).
- Total dietary fiber: Wheat (10.9%) has significantly more (P <0.05) fiber than millet (2.7%) and sorghum (5.2%).
- Protein: Millet and wheat have similar protein levels (10.75% and 13.21%, respectively) which are higher than sorghum's 7.67%.
- Total lipid: Millet has the highest lipid level at 4.93%, with sorghum next at 3.45% and wheat lowest at 2.50%.

Vitamins (See Figure 2)

- Wheat is higher than sorghum in thiamin and higher than both millet and sorghum in riboflavin.
- Niacin (not shown) and vitamin B₆ are not significantly different among the three types of flour.
- Millet flour is lower than the other two types of flour in vitamin E.

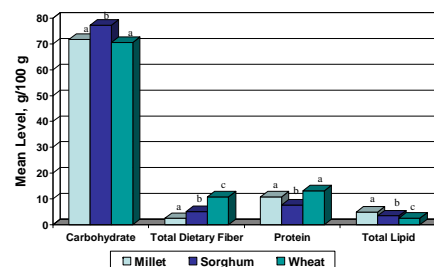
Minerals (See Table 1)

- Magnesium, sodium, and zinc are not significantly different among the three types of flour.
- Wheat is highest in calcium, manganese, phosphorus, and potassium content at 34, 4.07, 357, 363 mg/100g, respectively.
- Millet is highest in copper content at 0.54 mg/100g.

Fatty Acids (See Figure 3)

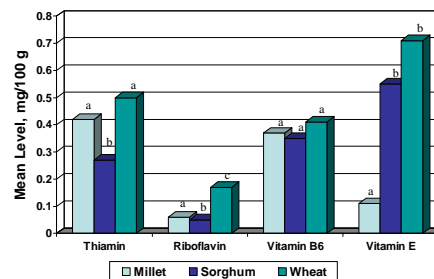
- The largest proportion of fatty acids in each flour is polyunsaturated.
- Millet and sorghum flours have a larger proportion of monounsaturated fatty acids than wheat flour.

Figure 1. Carbohydrate, total dietary fiber, protein and total lipid in millet, sorghum and wheat flours¹



¹For each nutrient, different letters indicate means are significantly different (P <0.05).

Figure 2. Quantity of select vitamins found in millet, sorghum and wheat flours¹



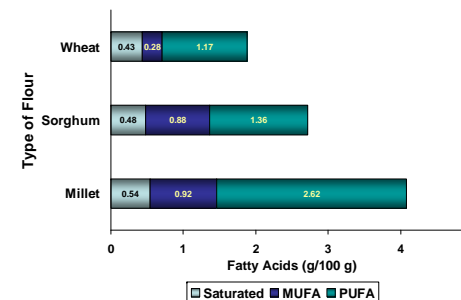
¹For each nutrient, different letters indicate means are significantly different (P <0.05).

Table 1. Mineral composition per 100 g of millet, sorghum and wheat flours¹

Mineral	Millet	Sorghum	Wheat
Ca, mg	12 ^a (1)	12 ^a (1)	34 ^b (1)
Fe, mg	3.71 ^{ab} (0.94)	2.81 ^b (0.17)	3.60 ^a (0.15)
Mg, mg	115 ^a (7)	115 ^a (7)	137 ^a (9)
P, mg	275 ^a (13)	285 ^a (9)	357 ^b (3)
K, mg	218 ^a (9)	309 ^b (3)	363 ^c (12)
Na, mg	4 ^a (0)	4 ^a (0)	3 ^a (0)
Zn, mg	2.46 ^a (0.38)	1.47 ^a (0.03)	2.60 ^a (0)
Cu, mg	0.54 ^a (0.39)	0.22 ^b (0.01)	0.41 ^c (0.01)
Mn, mg	1.01 ^a (0.03)	1.22 ^a (0.10)	4.07 ^b (0.38)
Se, µg	33.2 ^a (6.8)	10.6 ^b (0.8)	35.2 ^{ab} (10.0)

¹Values are means with standard errors in parentheses. For each nutrient, means within a row followed by different letters are significantly different (P <0.05).

Figure 3. Proportion of saturated, monounsaturated (MUFA), and polyunsaturated (PUFA) fatty acids in millet, sorghum and wheat flours



CONCLUSION

Nutrient content for proximate components, vitamins, minerals, and fatty acids in sorghum and millet flour will be included in SR23, and the nutrient values for whole wheat flour will be updated. This will provide an easily available source of nutrient information for sorghum and millet flours for people who are trying to follow a gluten-free diet as well as the general public.

REFERENCES

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- U.S. Department of Agriculture, Agricultural Research Service (USDA). 2009. USDA National Nutrient Database for Standard Reference, Release 22. Nutrient Data Laboratory Home Page, <http://www.ars.usda.gov/nutrientdata>