A Comprehensive Nutrient Content Database of Grains and Legumes Produced in Australia

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Key messages

- First ever comprehensive nutrient analysis of Australian grown grains and legumes
- Showcase Australian grains and legumes, improve accuracy of dietary analyses and assist new food product development
- Provide signals around nutrition targets for the plant breeding industry and producers

Aims

No database of nutrients important for human health currently exists for grains and legumes produced in Australia. Government bodies, grain traders, food manufacturers and health care professionals currently rely on databases quoting analytical data that is a mixture of data from grains produced in Australia, North America and Europe. However, the nutrient content of grains and legumes grown in Australia and used to produce food in Australia are likely to be distinctly different to those grown in other countries. The Grains & Legumes Nutrition Council (GLNC) is addressing this gap by developing the first ever comprehensive national grains and legumes nutrient database. The analysis will be a valuable asset across the grains value chain from breeders and growers through to the domestic food industry and exporters. It will also provide key information to food regulators and the public health sector in determining current nutrient intakes from grains and legumes.

To help combat the high rates of chronic disease such as diabetes and heart disease as well as obesity[1] public health agencies around the world are promoting foods of higher nutritional value[2,3,4]. A database of the nutrient content of grains and legumes currently grown in Australia would help inform breeders and growers of potential unique opportunities to boost the nutrient content of Australian grains and legumes to meet these needs. By identifying nutrients lacking in Australian grains or in specific grains, new varieties could be developed to improve the nutrient profile of Australian grains and legumes to make them more competitive on the domestic and the global market.

Public health initiatives focussed on nutrition are leading consumers around the world to look for foods with enhanced health benefits. This demand is being met by the food industry developing ‘better for you’ products. The information on the nutrient content of a variety of grains would increase the likelihood of innovative changes to wheat foods by encouraging incorporation of unique grains into traditional wheat based foods to boost the nutrient content of the food.

Matched with the increased consumer demand is the recent change to regulation in Australia and New Zealand that allows food manufacturers to make claims about the health benefits of foods. This provides a new avenue for food manufacturers to promote products based on health benefits of specific ingredients. This is leading to renovation of products to match consumer demand for specific health effects such as beta glucan for cholesterol lowering or arabinoxylan fibre for blood glucose control[5]. This in turn will drive demand for ingredients higher in these nutrients. A database of nutrient content of grains would assist food technologists choose appropriate grains to encourage renovation using grains grown in Australia.

With higher value being placed on the nutrient content of ingredients, and increased demand both domestically and globally, a comprehensive database is an innovative way for grain traders to showcase Australian grains as distinct to grain in other markets.

The first step towards a comprehensive database was a pilot project analysing the nutrient content of single samples of intact and minimally processed grains and legumes. The aim of the GLNC pilot project, completed in 2013, was to determine if a more comprehensive analysis of samples from representative growing regions across Australia was warranted.

Methods

In the pilot project, 30 single samples of intact grains and legumes harvested in Australia in 2012

were analysed or calculated by a NATA accredited laboratory using standardised techniques for nutrients important for human health.

The 30 samples included 10 intact grains, four main wheat grades (APH, AH, APW, ASW), six grains as commonly processed for food ingredients and 10 intact legumes (table 1). Samples were taken from the GRDC classified Northern and Southern Regions. Grain varieties were not individually analysed as the pilot was considering sources of grains as they are supplied as ingredients to processors and manufacturers. Nutrients were analysed in duplicate using the relevant NATA accredited tests for the macronutrients, vitamins, minerals and different fibre types as listed in Table 2. The data was then compared to nutrient content data for grains and legumes produced in the US using the USDA National Nutrient Database for Standard Reference[6].

Table 1 Samples analysed

Intact Grains	Wheat Grades	Processed grains	Intact legumes
Barley, pearled	Wheat, APH	Maize, grits	Chickpeas, desi
Buckwheat, whole	Wheat, AH	Oats, rolled	Chickpeas, kabuli
Maize, whole	Wheat, APW	Rye, rolled	Beans, faba
Millet, hulled	Wheat, ASW	Sorghum, kibbled, red	Peas, green, whole
Oats, whole, hulled		Triticale, kibbled	Lentils, French
Rice, brown		Rice, white	Lentils, green
Rye, whole			Lentils, red
Sorghum, whole, red			Lupin, whole
Spelt, whole			Mung beans, whole
Triticale, whole			Peas, yellow, whole

Table 2 Nutrients analysed

Macronutrients	Micronutrients	Fibres
Energy	Minerals	Dietary Fibre
Carbohydrate	Calcium	Total Dietary Fibre
Resistant Starch	Iron	Insoluble Dietary Fibre
Total Starch	Magnesium	Soluble Dietary Fibre
Sugars	Sodium	Beta-Glucan
Protein	Phosphorus	Inulin
Fat	Selenium	
Total fat	Zinc	
Saturated	Vitamins	

Macronutrients	Micronutrients	Fibres
Trans	Vitamin B1 (Thiamine)	
Poly-unsaturated	Vitamin B2 (Riboflavin)	
Mono-unsaturated	Vitamin B6 (Pyridoxine)	
Omega 3	Vitamin E	
Omega 6	Vitamin B3 (Niacin)	
Omega 9		

Results

Results of nutrients in selected samples from the pilot study are shown in Table 3 and 4. The nutrients listed in Table 3 and 4 were selected as grains are the leading contributors of protein, fibre, iron, magnesium, zinc, niacin and thiamine in the Australian diet. Vitamin B2 was also included to highlight differences identified when compared to US data.

The nutrient content of selected grains and legumes varied by grain type as shown in Table 3. For example wheat, barley, and triticale are higher in fibre

The data in Table 4 indicates the comparison between Australian grown grains with US data. The comparison indicates some differences of note. In some cases the nutrient content is higher in the Australian samples compared to the data in the USDA National Nutrient Database, such as the polyunsaturated fat level in barley.

Other nutrients are lower in Australian grown grains, such as Vitamin B2 levels, which are lower in a number of grain samples from Australia compared to data from the USDA National Nutrient Database. The fibre content of the buckwheat samples was also significantly lower compared to data from the USDA National Nutrient Database.

Conclusion

The results of the GLNC pilot study indicate the nutrient content of grains produced in Australia varies by grain type and the nutrient content of grains produced in Australia does differ from those grown overseas.

The existence of differences in the content of nutrients important for human health between grains grown in Australia compared to other countries is a potential opportunity. As demand shifts towards grains with improved nutritional qualities it is important that grains grown in Australia can compete on a global market. Australian grown grains appear to be lower in vitamin B2 and some specific grains are lower in fibre than the same grains grown in other countries. Vitamin B2, riboflavin, is important for the maintenance of a variety of functions in the body including the nervous system, metabolism of iron, maintenance of red blood cells, normal vision and the reduction of fatigue. The lower levels identified in a number of Australian grains is of interest as, to the authors' knowledge, this has not been reported previously in published literature related to human health. While a number of factors may affect bran and therefore vitamin content, this comparison represents a potential opportunity to explore further. Breeders and growers may be able to improve the nutrient content of Australian grains by improving the level of specific nutrients such as vitamin B2. Mandatory fortification regulations requires Vitamin B1 and folate be added to all wheat flour for bread making in Australia and New Zealand. However, as new grains are added to wheat flour for bread making this may dilute the effect of the fortification if the grains do not naturally contain adequate amounts.

The differences in the nutrient content of different grains seen in the pilot demonstrates how a comprehensive database could be used by the food industry to select specific grains or

legumes to incorporate into traditional wheat based foods to boost the nutrient content of the food.

However, the pilot is a limited sample set with only single samples from one region taken of each grain in a single year. Further analysis of the nutrient content of grains and legumes from representative growing regions across Australia is needed to produce a comprehensive database. Such an analysis will provide a more accurate picture to help identify nutritional attributes of Australian grown grains that may be leveraged on the world market. It will additionally provide focus for breeders and producers for nutrients to select for in order to improve the nutrient profile of Australian grown grains.

In addition, analysing the nutrient profile of grains and legumes processed to ingredients, in combination and included in standard foods, is vital to provide information to the food industry in order to drive innovation and renovation of wheat-based foods which in turn will bolster the demand for wheat.

To establish the comprehensive database of the nutritional profile of grains and legumes produced in Australia, GLNC is working with stakeholders to determine how to select representative samples and define the scope of the project to ensure the outcomes are optimised for use across the grains and legumes value chain. Work on the large scale project is scheduled to commence in 2014. The project will determine the nutrient profile of representative samples of grains and legumes produced in selected growing regions across Australia both whole and processed into ingredients and foods. The data from Australian grown grains and legumes will also be compared to data from various key competitor markets.

Key words

Nutrition, health, legumes, grains

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Table 3 Nutrient content of single samples of most commonly grown grains and legumes

Nutrient	Wheat APH	Barley	Oats	Lupins	Field Pea	Sorghum	Spelt	Triticale	Brown rice	Buck-wheat	Chick pea kabuli	Recommended Daily Intake for Adults
Protein (%)[#]	13.8	9.9	11.1	28.3	22	8.4	11.7	10.6	7.6	12.2	18.2	N/A
Total Fibre (%)	11.6	13.1	?	43.1	16.8	9.0	8.8	14	3.5	5.0	13.5	25 – 30 g
Soluble fibre (%)	2.4	5.2	?	1.8	1.2	1.3	1.0	1.5	1.4	0.9	1.2	N/A
Insoluble fibre (%)	9.2	7.9	4.6	41.3	15.6	7.7	7.8	12.5	2.1	4.1	12.3	N/A
Iron (mg/100g)	4.2	2.2	3.9	4.0	5.9	2.8	2.8	3.1	0.8	3.0	4.1	8 – 18 mg
Magnesium (mg/100g)	125.0	95.0	117.0	165.0.	121	129.0	122.0	102.0	119.0	199.0	123.0	310 – 400 mg
Zinc (mg/100g)	2.1	1.2	2.3	2.8	3.6	1.5	1.9	1.3	1.7	2.9	2.2	8 – 14 mg
Vitamin B1 (Thiamine) (mg/100g)	0.5	0.2	0.31	0.58	0.92	0.4	0.4	0.37	0.37	0.57	0.6	1.1 – 1.2 mg
Vitamin B2 (Riboflavin) (mg/100g)	0.1	0.0	0.01	0.02	0.02	0.03	0.03	0.03	0.01	0.03	0.02	1.1 – 1.3 mg
Vitamin B3 (Niacin) (mg/100g)	4.4	6.6	1.2	1.6	2.3	4.2	7.3	1.7	5.8	4.4	1.2	14 – 16 mg

[#]Protein calculated as N x 5.7, N/A not available

Table 4 Pilot study data compared to US data for content of key nutrients

Nutrient	Wheat – APH	US wheat**	Australian barley	US barley**	Australian oats	US oats**	Lupins	Field Pea
Protein (%)[#]	13.8	9.6	tbc	9.9	11.1	16.89	31.0	22
Total Fibre (%)	11.6	13.1	13.1	15.6	tbc	10.6	43.1	16.8
Iron (mg/100g)	4.2	3.7	2.2	2.5	3.9	4.72	4.0	5.9
Magnesium (mg/100g)	125	117	95	79	117	177	165	121
Phosphorus (mg/100g)	313	323	192	221	305	523	249	3.6
Zinc (mg/100g)	2.1	2.9	1.2	2.13	2.3	3.97	2.8	0.92
Vitamin B1 (Thiamine) (mg/100g)	0.5	0.3	0.17	0.191	0.31		0.58	0.02
Vitamin B2 (Riboflavin) (mg/100g)	0.1	0.2	0.02	0.114	0.01		0.02	2.3
Vitamin B3 (Niacin) (mg/100g)	4.4	5.3	6.6	4.6	1.2		1.6	5.9

[#]Protein calculated as N x 5.7, *Flour, wholegrain soft wheat **Data sourced from USDA National Nutrient Database for Standard Reference[6]