Hulless Barley Potential Opportunities

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Alberta Agriculture and Forestry
Economics and Competitiveness Division
Competitiveness and Market Analysis Branch

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Contact: Sarah Oliveira, Market Researcher
Competitiveness and Market Analysis Branch
#302, 7000-113 Street
Edmonton, AB, T6H 5T6
Phone: (780) 422-0264
Fax: (780) 427–5220
Email.sarah.oliveira@gov.ab.ca

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Executive Summary

Barley is a multi-purpose crop grown for food, malting and general purposes (feed) across the Canadian Prairies. Barley is the second largest cereal crop in Alberta. The purpose of this report was to research the potential of hulless barley as malt, feed and food.

Malting/Brewing

Despite the availability of hulless barley varieties with exceptional malt quality potential, commercial demand has been limited. Large commercial maltsters and brewers remain skeptical due to potential processing concerns, such as stickiness of hulless barley during processing and acrospires loss. Brewers tend to be very traditional and they don't like any change that might alter the character of the beer. The brewing industry has spent years developing barley varieties that perform well in the traditional brewing process and give them the results they want. It is unlikely they would be very open to moving to other varieties, such as hulless barley, without a very compelling economic incentive for them to do so.

Livestock Feed

There may be a potential to use hulless barley as sprouted fodder. The main benefit of sprouted fodder in comparison to feeding grain is "improved protein, starch and sugar" profile. Nearly all of the starch present in the grain is converted to sugar by sprouting, which is better utilized by the rumen than the dry grain. This reduces acidosis problems, as the rumen pH stays more stable without the constant input of starch. Mineral and vitamin levels in hydroponically-sprouted barley are significantly increased over those in grain; in addition, they are absorbed more efficiently due to the lack of enzyme inhibitors in sprouted grain. Sprouts provide a good supply of vitamins A, E, C and B complex. The vitamin content of some seeds can increase by up to 20 times their original value within several days of sprouting. Barley sprouts the best, grows the fastest and is most cost-effective in extensive experiments compared to wheat and oats.

Food

As cereal grains go, barley is a winner when it comes to human nutrition. This centuries-old grain is packed with fiber, contains important vitamins and minerals, is low in fat, and cholesterol-free.

Barley already has the ability to use the Heart/Stroke symbol. There are rules and regulations that need to be followed for it to be used.

Since barley is a healthy grain with a lot of fiber there could be opportunities to work with the food industry to create recipes or with the food processing industry to create products.

There has been a lot of research done on the health benefits of barley. Major health concerns are obesity, heart health, high cholesterol, which barley being high in fiber, maybe able to help. One interesting product is barley pasta. Research done by University of California researchers showed that high fiber (15.7g) barley pasta blunted insulin response, and four hours after the meal, barley pasta eaters had significantly lower cholesterol concentration than those fed wheat pasta.

There may also be an opportunity to supply sprouted grains to the bread baking industry as this is another area of interest by consumers.

Conclusion

There are opportunities to use hulless barley but a few obstacles need to be overcome.

1. Either better yields so farmers will grow it or premium pricing to make up the difference in yield and potential returns.
2. Work with chefs to encourage more use of barley on their menus.
3. Work with the processing industry to encourage more product innovation using barley.
4. Increase the availability of hulless barley. If work were to be done on something like barley pasta and a pasta company such as Catelli were to become interested a consistent supply would be needed.

An Overview of Alberta's Barley Industry

Barley is the second largest cereal crop in Alberta. In 2014, there were an estimated 2.8 million acres harvested and an estimated production of 4.13 million tonnes. Eighty per cent goes to feed, 19 per cent to malt and one per cent is used for human consumption. In terms of seeded acres 55 to 57 per cent is seeded to feed barley and 43 to 45 per cent is seeded to malt barley.

It was hard to get an accurate number of hulless barley acreage but according to Bill Chapman, a Crop Business Development Specialist with Agriculture and Forestry, the figure was less than one per cent of seeded acres. Agriculture Financial Services Corporation lists insured acres of hulless barley at 6,963 acres. The hulless barley varieties listed for the 2013 crop year were Falcon, Condor and CDC McGwire. The three most common types of barley grown in Western Canada and Alberta are AC Metcalfe, CDC Copeland and CDC Meredith.

Registered Hulless Barley Variety

There are twenty varieties of two-row, spring, hulless barley, eight varieties of six-row, spring, hulless barley and four varieties of two-row, waxy, hulless barley with National Registration. A complete list of hulless barley varieties can be found at http://www.inspection.gc.ca/active/netapp/regvar/regvar_lookupe.aspx

Alberta Barley Exports

Alberta's barley exports were $194.2 million in 2014. The following table lists the countries that have imported at least $1 million of Alberta barley in the 2014. China, the United States and Japan have shown consistent growth over the last four years in their barley imports.

Countries	2010	2011	2012	2013	2014
China	$22,501,935	$21,267,870	$40,029,020	$51,945,715	$76,800,477
United States	$13,694,244	$21,224,536	$63,529,985	$59,221,891	$66,632,058
Japan	$12,583,617	$37,160,827	$49,155,981	$40,830,230	$34,080,766
Colombia	$5,196,990	$5,700,949	$10,398,292	$8,366,041	$6,277,033
Saudi Arabia	$13,449,893	$18,707,257	$10,174,625	$6,905,298	$6,105,245
Ecuador	$599,505	$641,862	-	$1,179,653	$1,849,508
Peru	$1,584,016	-	$111,652	-	$1,191,980

Source: Alberta Agriculture and Forestry - Statistics and Data Development Branch

Canada/Alberta Malt Exports Roasted or Unroasted

The following tables show Canada and Alberta exports of Malt Roasted or Unroasted. Please note that these figures also include some wheat malt.

Table 2 - Canada Agri-Food Exports - 145 Malt Roasted or not Roasted – Value $CDN

All Countries		**2010**	**2011**	**2012**	**2013**	**2014**
11071000	Malt, not roasted	312,335,362	321,787,422	382,519,038	364,888,676	414,426,122
11072000	Malt, roasted	71,249	90,556	87,340	443,862	57,742
	Total Exports	**312,406,611**	**321,877,978**	**382,606,378**	**365,332,538**	**414,483,864**

Quantity						
All Countries		**2010**	**2011**	**2012**	**2013**	**2014**
11071000	Malt, not roasted	578,001	585,851	595,524	548,837	628,758
11072000	Malt, roasted	26	115	97	559	60

Quantity in TNE

Source: Alberta Agriculture and Forestry, Statistics and Data Development Branch

Table 3 - Alberta Agri-Food Exports - 145 Malt Roasted or not Roasted – Value in $CDN

		2010	**2011**	**2012**	**2013**	**2014**
All Countries						
11071000	Malt, not roasted	142,744,693	151,468,815	179,951,961	174,586,049	225,543,012
11072000	Malt, roasted	-	32,463	1,622	12,650	57,742
	Total Exports	**142,744,693**	**151,501,278**	**179,953,583**	**174,598,699**	**225,600,754**

Quantity=TNE						
All Countries						
		2010	**2011**	**2012**	**2013**	**2014**
11071000	Malt, not roasted	273,084	288,609	291,854	272,435	349,899
11072000	Malt, roasted	0	44	3	0	60

Source: Alberta Agriculture and Forestry, Statistics and Data Development Branch

Alberta exported $225.6 million of malt (roasted or not roasted) in 2014. The United States was our biggest export market buying 52 per cent of our malt in 2014. Japan was the second largest importer of malt.

Table 4 - Alberta Agri-Food Exports - Malt Roasted or not Roasted - Value $

	2010	2011	2012	2013	2014
All Countries					
United States	54,667,881	45,049,835	48,701,178	71,192,027	116,504,425
Japan	52,422,263	55,601,289	67,201,388	70,383,470	68,357,923
Korea, South	1,376,950	7,857,494	13,257,938	8,301,976	14,418,205
Costa Rica	3,088,699	7,376,581	3,580,035	2,187,240	10,300,024
Mexico	-	-	-	-	7,355,626
Venezuela	5,017,181	-	12,052,818	5,974,093	3,346,841
Panama	-	218,265	1,608,521	1,848,410	1,996,268

Source: Alberta Agriculture and Forestry, Statistics and Data Development Branch

Barley Production in Western Canada

Barley is a multi-purpose crop grown for food, malting and general across the Canadian Prairies. Table 5 shows the comparison of barley production in Western Canada for 2014 and 2013 along with the ten year average production.

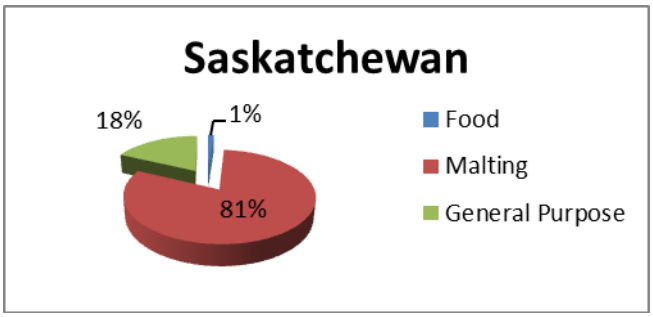
Table 5 – Comparison of Barley Production in Western Canada for 2014 and 2013 with the Ten Year Average Production

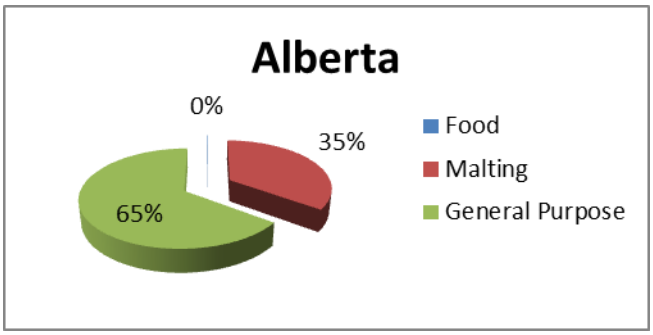
	Seeded area (Millions of Hectares)			**Production (Millions of Tonnes)**		
	2014	2013	2005-2014 Avg.	2014	2013	2005-2014 Avg.
Manitoba	0.132	0.182	2.594	0.414	0.705	0.75
Saskatchewan	0.789	1.024	1.274	2.105	3.412	3.353
Alberta	1.354	1.503	1.626	4.181	5.631	4.779
Western Canada	**2.275**	**2.709**	**3.159**	**6.700**	**9.748**	**9.192**

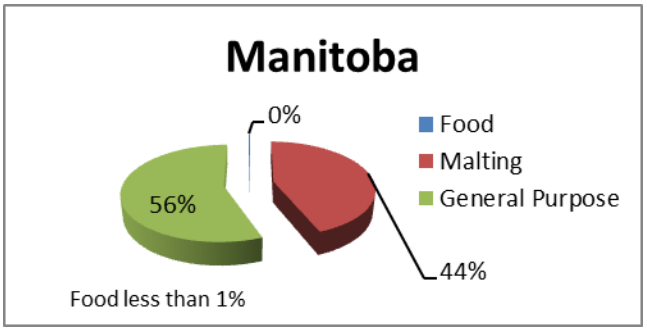
Source: Canadian Grain Commission

In 2014, 2-row malting barley occupied the majority of acres in Saskatchewan, while the majority of barley produced in Alberta was grown for feed and forage purposes. In Manitoba, 44 per cent of acres were seeded to malting barley, whereas 56 per cent was seeded to general purpose. Food barley continues to occupy a relatively small per cent of seeded acres in each province. The charts below show the distribution of barley classes as a per cent of total area seeded to barley in the three Western Canadian provinces in 2014 malting barley is second with food barley being less than one per cent

in Alberta and Manitoba. Saskatchewan had 81 per cent malting barley and 18 per cent general purpose barley.







Source: Canadian Grain Commission

Barley as Livestock Feed

Most general purpose barley is used as feed for livestock. In Alberta, as much as 80 per cent of all barley grown in Alberta every year is used as feed. Much of that is used by Alberta's cattle industry, resulting in beef that is finely textured and delicately marbled with white fat. Barley is also used to feed hogs, poultry and sheep in Alberta. http://www.albertabarley.com/our-priorities/barley/classes/general-purpose-feed/

In a report titled “Nutrition and Management: Effect of Barley Grain Type on Feedlot Performance of Steers” by Alberta Agriculture and Forestry the take home messages were:

1. The main reason for feeding barley to feeder cattle is to improve gains by providing a concentrated source of energy which comes from the starch.
2. About 90 per cent of this starch is degraded in the rumen.
3. Rapid starch degradation in the rumen is undesirable since it lowers rumen pH, depresses fibre digestion, and causes liver abscesses and digestive disturbances such as acidosis, rumenitis and bloat.
4. It may be possible to select barleys with slower dry matter (DM) degradation rates.

Some researchers have reported differences in feed value among cultivars of barley for cattle. These have included differences of 10 per cent for average daily gain (ADG), five per cent for feed DM:gain ratio, and 10 per cent for digestible energy (DE). Although the reasons for these differences have not been determined, it has been suggested that head morphology (two-row, six-row), growth habit (winter, spring), and intended end-use (malting, feed) are probably the most useful indicators of barley nutritional quality. Hulless barley has become available as a feed grain in recent years and has proven to be superior to hulled barley for monogastric animals. Limited studies are available in which hulless barley has been fed to cattle.

Economic Disadvantage of Hulless Barley

One of the disadvantages of using hulless barley is the yield.

In an email received from Dr. Aaron Beattie, Assistant Professor with the Barley and Oat Breeding Program with the University of Saskatchewan gave me these figures.

These figures are using AC Metcalfe, the most commonly grown 2-row hulled barley variety in Western Canada as a base of 100 per cent. Newer varieties are narrowing the yield gap, but each year is different in terms of weather. Newer hulled varieties are yielding better as well, so the yield gap with hulless barley remains a considerable challenge.

Hulled Barley	Yield	Hulless Barley	Yield
CDC Copeland	105%	HB13324	102%
CDC Meredith	110%	CDC McGwire	98%
Bentley	110%	CDC Clear	98%
Xena	113%	CDC Rattan	90%
CDC Austenson	115%		

Looking from a farmer's point of view, growing hulless barley is not in their economic best interest. Take this following simplified scenario.

In the following example I have used available data from www.seed.ab.ca for yield and the Western Producer for barley feed prices.

The farmer decides to grow an acre of malt barley in the hopes of making malt grade. Five-year average yield for barley per acre is 67.54 bushels. If he makes malt grade his revenue, (based on prices quoted by western producer at $5.40 to $5.50), taking the low price.
67.54 bu/acre x $5.40= $364.72

If he doesn't make malt grade his revenue would be:
67.54 bu/acre x $3.78 = $255.30

Now, if he grows hulless barley he starts off with a yield disadvantage. Hulless barley yields are 9 – 12 per cent lower than hulled barley. So taking a middle ground of 10 per cent yield difference gives the farmer 60.79 bu/acre. Since hulless barley is not really used for malting purposes feed prices are used.

60.79 x $3.78 = $229.00

Growing malt barley but only getting feed prices a farmer's revenue is $255.30/acre. Growing hulless barley and making feed grade only gives him $229.30/acre.

In order for a farmer to be interested in growing hulless barley somehow through either contracts or premium pricing he would need to make up for the difference in revenue.

Sprouted Fodder as a Potential use for Hulless Barley

Sprouted fodder is not a new idea. There are references to sprouting small grains for fodder dating back at least to the 1600s. What is new is the technology and engineering that makes it more economical. Light, moisture and consistent heat are critical for sprouted fodder to work. Attempts have been made using greenhouses to produce the sprouts, but have proven difficult and expensive for controlling humidity and heat. Greenhouses are just not consistent enough for reliable fodder production.

What has revolutionized sprouted barley fodder as a viable feed alternative is high efficiency fluorescent and LED lighting and more affordable climate control systems. LED lighting in particular is very energy efficient with little excess heat generated.

Although LED is more expensive to buy upfront, the long-term operating expenses are greatly reduced. LEDs also last much longer than any other option, and do not lose output over time.

Nutritional Benefits

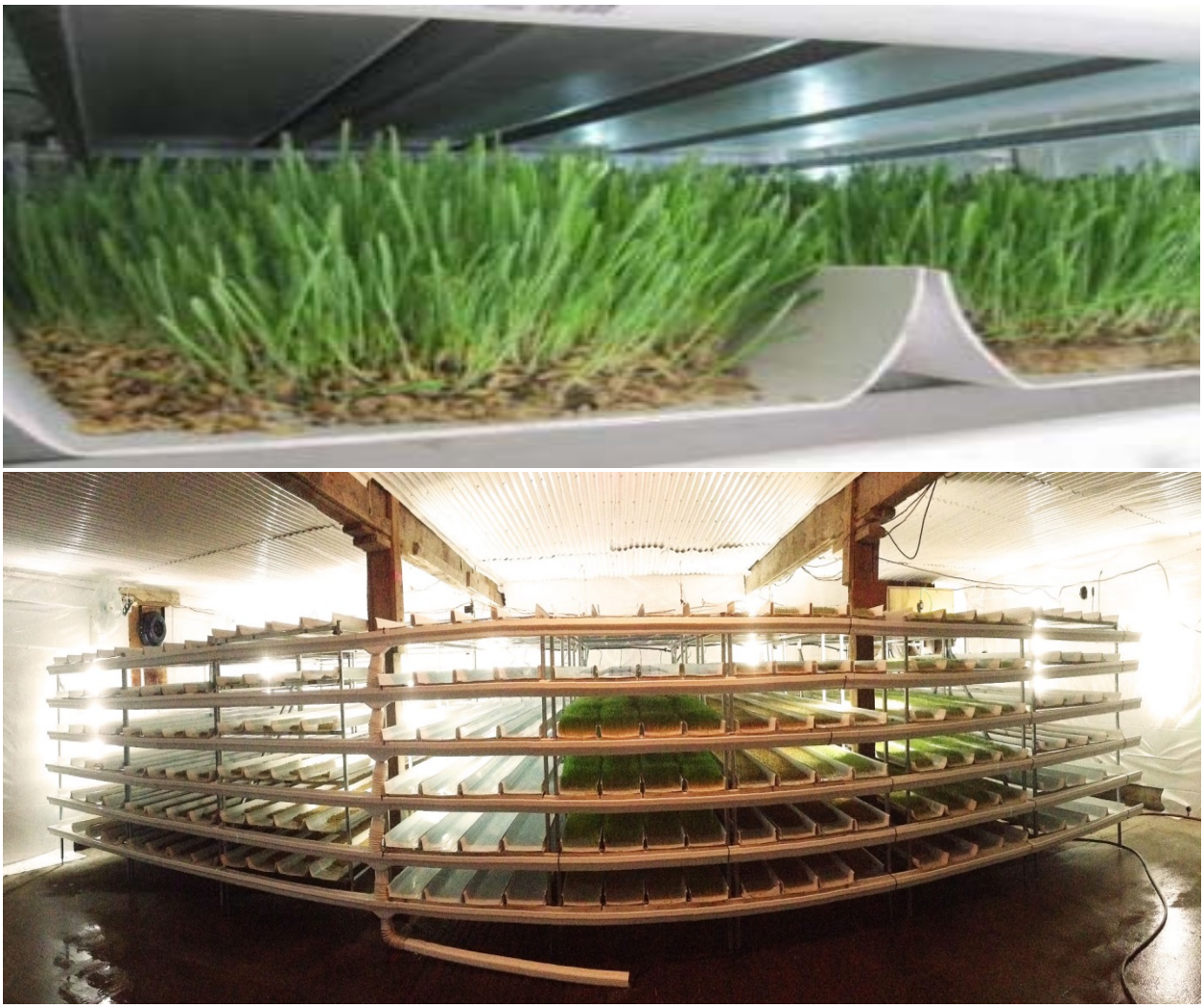
The main benefit of sprouted fodder in comparison to feeding grain is “improved protein, starch and sugar”. Nearly all of the starch present in the grain is converted to sugar by sprouting, which is better utilized by the rumen than the dry grain. This reduces acidosis problems, as the rumen pH stays more stable without the constant input of starch.
“Mineral and vitamin levels in hydroponically-sprouted barley are significantly increased over those in grain. In addition, they are absorbed more efficiently due to the lack of enzyme inhibitors in sprouted grain. Sprouts provide a good supply of vitamins A, E, C and B complex. The vitamin content of some seeds can increase by up to 20 times their original value within several days of sprouting.
When a cow eats fresh sprouted fodder, it is eating digestive enzymes that are not present in dry hay or in grain. It is highly digestible and nutritious.
There is very little dry matter in sprouted barley fodder (17%), thus, a farmer feeding it must also provide dry hay, but the hay does not have to be of highest quality.

Why Barley and Not Other Small Grains?

Barley is the most nutritious of the small grains, stores well and is easy to grow. Feed Your Farm, one of the companies supplying sprouting systems, has experimented extensively with wheat and oats, but has found that barley sprouts the best, grows the fastest and is most cost-effective of all the grains tried. To work well for sprouted fodder, the barley seed needs a high germination rate and must be very clean. Some companies recommend mixing seeds–a favorite of Fodder Feeds is two pounds of barley and two ounces of sunflower seeds, which yields 20 pounds (on average, a 10:1 ratio) when sprouted in their system.

A general rule of thumb is a yield of 1:7– one pound of barley seed will produce seven pounds of sprouted fodder.

This may be of interest to hobby farms or the organic farming community since barley is not genetically modified.



Pictured above is sprouted barley and a sample of a system used to sprout barley.

Barley Use in the Malting Industry

In recent years, a small number of varieties have dominated the portfolio of malting barley cultivars currently being grown in Western Canada. AC Metcalfe remains the most popular malting variety occupying 38.9 per cent of total acres seeded to malt barley in 2014. CDC Copeland continued in second place with 29.8 per cent of acres, and eighty to ninety per cent of the malt barley production is contracted by malting companies. (Canadian Grain Commission)

The Malting Companies in Canada are Cargill in Biggar, Saskatchewan, Rahr in Alix, Alberta, Graincorp/Canada Malting in Calgary, Montreal and Thunder Bay and Malteurop in Winnipeg. These malting plants buy about 1.1 million tonnes of malting

barley. Internal estimates suggest the companies export around 600,000 tonnes of malt, around 65 per cent of their production.

Hulless Barley for Malting in Canada

According to the Canadian Grain Commission, hulless barley, with its high level of digestible energy for feeding or high level of malt extract for brewing, has always intrigued end users.

In Western Canada, hulless barley first came into prominence with the registration of Scout in 1985. Scout was a hulless feed barley variety. Several more feed varieties followed. Many with inherent problems of adhering hulls, which along with poor price discovery, limited the commercial success of hulless barley for feed.

Investigations into the malting potential of hulless barley began in 1995. Results indicated a significant increase in extract level, which was encouraging. However, problems with adhering hulls, high levels of wort β-glucan as well as low friability were a concern. Commercial brewers were attracted to the high extract level along with reduced amounts of spent grain and lower transportation costs for hulless barley. Initial exploratory interest failed to translate to commercial interest. As mash filters became more common the lure of high extracts piqued the interest of one international brewer. They tried some small commercial trials with hulless barley malt and were encouraged by the results. This provided a reason to continue the development of hulless malting barley in Canada. Canadian breeders began making specific crosses to improve the malt potential of hulless barley, but objectives for breeding were not well defined.

Table 6 - Timelines for Development of Hulless Barley for Malting in Western Canada

1985 Scout released; 1st Canadian hulless (feed) barley
1995 Numerous hulless feed barley varieties released in the 1990's
Condor, Flacon, AC Bacon, CDC Dawn, CDC McGwire
2000 International brewers investigate hulless barley malt from Canada
2005 Release of hulless barley Wort β-glcan (low) varieties specifically for malting
CDC ExPlus Taylor 6
2010 Specialized Malts produced commercially from Canadian hulless barley

Future of Hulless Barley for Malting

The future of hulless barley for malt was given a boost when the malting and brewing industry indicated high extracts was their major interest in hulless barley malt. They suggested breeders limit their quality objectives to reducing adhering hulls, lowering grain protein, increasing malt extract, and decreasing wort β-glucan. Enzymes, soluble protein and other commonly analysed malt parameters were not as big a concern. Any commercial use of hulless barley malt would be limited to blends with covered malts, and the covered malts would supply all the necessary enzyme and soluble protein. Breeders have since concentrated on improving these specific aspects of quality, along with agronomic objectives, and the first hulless barley varieties bred specifically for malting were registered in 2009 (CDC ExPlus, Taylor).

Table 7 – Malt Quality of Recently Released Hulless Barley Varieties

Varieties	Grain Protein (% dm)	Malt Extract (%)	Wort B-glucan (ppm)
CDC McGwire	9.2	88.3	364
CDC ExPlus	9.5	89.2	130
Taylor	9.6	89.7	83
HB08304*	9.1	90.7	88
* recommended for registration 2011			

Source: Canadian Grain Commission

Despite the availability of hulless barley varieties with exceptional malt quality potential, commercial demand has been limited. Large commercial maltsters and brewers remain skeptical due to potential processing concerns, such as stickiness of hulless barley during processing and acrospires loss.

According to a former master brewer for Labatts, Alan Hayman, you would have to change some of the brewing equipment if you wanted to use hulless barley, specifically, you would need a lauter tun and the barley hulls become a filter bed that allows the brewer to separate the clear wort from the grain residue. You would need to have a centrifuge or some other way of separating the wort from the mash which would mean changing the brewing equipment. Brewers tend to be very traditional and they do not like any change that might alter the character of the beer. The brewing industry has spent years developing barley varieties that perform well in the traditional brewing process and give them the results they want. It is unlikely they would be very open to moving to other varieties, such as hulless barley, without a very compelling economic incentive for them to do so.

Regardless of the quality of hulless barley, AC Metcalfe continues to be the dominant malting barley variety grown in Western Canada. With high levels of extract and

diastatic enzymes, its reputation for excellent brewing performance generates strong demand from both domestic and export markets.

Food Possibilities for Hulless Barley

Hulless barley has higher crude protein and lower crude fibre than hulled barley, as the hull accounts for a large proportion of the crude fibre content of the kernel. It also contains higher levels of the polysaccharide β-glucan. This compound is considered undesirable for malting barley since it interferes with the starch modification process. However, β-glucan is highly desirable when barley is grown for food. For this reason, hulless varieties are being developed primarily for use as human food.

Another positive attribute of barley either hulless or hulled is that it is not genetically modified. This is important to some consumers and food companies who are trying to avoid genetically modified ingredients.

There are still the constraints of growing hulless barley in Canada that include lower yields, lack of a premium, and difficulty in segregating the product from hulled varieties within the grain transportation system.

According to the Barley Grain Feed Industry Guide from Alberta Barley hulless barley has a major advantage over conventional barley in transportation, processing, and storage. Removing the hull fraction increases the bulk density (weight-per-unit volume) compared to hulled barley by about 25 per cent, thus cost savings can be considerable.

As cereal grains go, barley is a winner when it comes to good nutrition. This centuries-old grain is packed with fiber, contains important vitamins and minerals, is low in fat, and, like all plant products, cholesterol-free.

Fiber

Barley is a great source of dietary fiber and actually contains both soluble and insoluble fiber. Soluble fiber is effective in lowering blood cholesterol and can reduce the risk of heart disease.

It is also beneficial in slowing the absorption of sugar and potentially reducing the risk of developing type 2 diabetes. The insoluble fiber found in barley may be beneficial in helping the body maintain regular bowel function. Insoluble fiber may also help lower the risk for certain cancers such as colon cancer.

Cholesterol and Fat

Like all plant foods, barley is naturally cholesterol-free and low in fat. A 1/2-cup serving of cooked pearl barley, a typical grain serving, contains less than

1/2 gram of fat and only 100 calories.

*Source: USDA National Nutrient Database for Standard Reference, 27

Vitamins and Minerals

Barley contains several vitamins and minerals including niacin, thiamine, selenium, iron, magnesium, zinc, phosphorus and copper.

Antioxidants

Barley contains antioxidants, which are also important for maintaining good health. Specifically, antioxidants work to slow down the rate of oxidative damage by gathering up free radicals that form when body cells use oxygen.

Phytochemicals

Barley contains phytochemicals, which are natural plant-based chemicals. Studies indicate that phytochemicals may help decrease the risk for certain diseases such as heart disease, diabetes and cancer.
http://www.barleyfoods.org/documents/wholearticlebarleynutritionpowerhouse.pdf

Is barley a good fiber choice?

Barley is an excellent choice when it comes to adding both soluble and insoluble fiber to the diet. Our favorite grain compares favorably to other grains in total dietary fiber content. For example, a 1/2-cup serving of cooked pearl barley contains 3 grams of total dietary fiber. In comparison, a 1/2-cup serving of cooked long-grain brown rice contains 1.75 grams dietary fiber. A 1/2 -cup serving of cooked white medium-grain rice contains less than 1 gram of dietary fiber.
http://www.barleyfoods.org/documents/wholearticlegetthefacts.pdf

Nutritional Content of Barley:
Nutritional value per 100 g (3.5 oz)
Energy 1,474 kJ (352 kcal)
Carbohydrates 77.7 g
- Sugars 0.8 g
- Dietary fiber 15.6 g
Fat 1.2 g
Protein 9.9 g
Thiamine (Vit. B1): 0.2 mg (15%)
Riboflavin (Vit. B2): 0.1 mg (7%)
Niacin (Vit. B3): 4.6 mg (31%)
Pantothenic acid: (B5) 0.3 mg (6%)

Vitamin B6: 0.3 mg (23%)
Folate: (Vit. B9) 23 Î¼g (6%)
Source: USDA Nutrient database

Barley contains the minerals calcium, chromium, copper, iron, magnesium, manganese, phosphorus, selenium and zinc. It also provides the amino acids alanine, arginine, aspartate, cystine, glutamate, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tryptophan, tyrosine and valine.

Waxy Hulless Barley Example

Light color grain with excellent nutritional and food qualities:

1. Whole grain Hulless Barley (14-16% protein, 2-3% crude fat, 8-10% insoluble fiber, 8-10% soluble fiber, 55-60% starch) contains 2-3 times the soluble fiber (SF) found in oat grains. The high quality SF reduces dangerous low density lipoprotein (LDL) cholesterol while maintaining the useful HDL cholesterol. Thus not only is total cholesterol reduced but the all-important HDL/LDL ratio is improved.

2. The cholesterol reducing compound D-alpha-tocotrienol (one form of Vitamin E) is found in the germ and aleurone. 20 ppm can reduce cholesterol by 15 per cent in three weeks. Hulless Barley flour averages 50 ppm.

3. Hulless barley is unique. It is the only cereal grain which contains high levels of cholesterol reducing compounds which work in two different ways:

Soluble fiber works in the gut to inhibit absorption of ingested cholesterol and remove bile. D-alpha-tocotrienol works in the liver to inhibit cholesterol synthesis.

4. Barley flour can be used in place of wheat in all food except leavened breads. In yeast breads up to 1/3 of the wheat flour can be substituted with barley flour with no reduction in loaf quality, but added healthy soluble fiber and tocotrienol.

5. The combination of hulless seed, waxy starch, and very high levels of soluble fiber yields an extremely palatable grain. In processing, barley kernels puff up double that of normal barley. The waxy starch has exceptional freeze-thaw stability, thus the flour is a valuable ingredient in products which require freezing.
Greg Fox, PhD, Chris Fastnaught, PhD Phoenix Seed Research

Barley already has the ability to use Heart/Stroke Foundation symbol. There are rules and regulations that need to be followed for it to be used.

Since barley is a healthy grain with a lot of fiber there could be opportunities to work with the food industry to create recipes or with the food processing industry to create products.

There has been a lot of research done on the health benefits of barley. Major health concerns are obesity, heart health, and high cholesterol which barley, being high in fiber, may be able to help. One interesting product that I came across is barley pasta. Research done by University of California researchers showed the high fiber (15.7g) barley pasta blunted insulin response, and four hours after the meal, barley pasta eaters had significantly lower cholesterol concentration than those fed the wheat pasta.
For further research studies that have been done you can go to
http://wholegrainscouncil.org/

Growth of Pot and Pearl Barley

Pot and Pearl Barley are the two most common forms of barley that are consistently available in retail stores.

The population of Canada in 2014 was 35.5 million people. Multiply this by 0.36 kilograms/per person/year) and you have approximately 12.7 million kilograms of barley being used for human consumption. If more products were consistently available such as barley flour or ready-to-eat barley products it would have the potential to increase barley consumption.

Table 8 Pot and Pearl Barley Consumption

Pot and Pearl Barley	2010	2011	2012	2013	2014
Kilos/per person/year	0.08	0.46	0.26	0.38	0.36

Source: Statistics Canada Table 002-0011

Conclusion

In my opinion, there are greater opportunities for hulless barley in the food for human consumption area than in the malting/brewing area. The reasons being:

1. Hulless barley has a major advantage over conventional barley in transportation, processing, and storage. Removing the hull fraction increases the bulk density (weight-per-unit volume) compared to hulled barley by about 25%, thus cost savings can be considerable.
2. Hulless barley does not need the hull removed so may save time and effort in processing.
3. Barley in general is not genetically modified so can be used in a wide variety of products without having to worry about trade barriers or consumer distrust of genetically modified ingredients.
4. Work with chefs to encourage more use of barley on their menus.
5. Work with the processing industry to encourage more product innovation using barley.

Unfortunately, there are still the obstacles that need to be overcome.

1. Either a better yield is needed so farmers will grow it or premium pricing is needed to make up the difference in yield and potential returns.
2. Increase the availability of hulless barley. If hulless barley caught the attention of a pasta company such as Catelli to make barley pasta you would need to have a consistent supply available.

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